

Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

H43.9
R312
Cof. 2

UNITED STATES DEPARTMENT OF AGRICULTURE

AGRICULTURAL RESEARCH SERVICE

ANIMAL HUSBANDRY RESEARCH DIVISION

and

COOPERATING WESTERN STATES

W-1 - IMPROVEMENT OF BEEF CATTLE THROUGH THE APPLICATION OF
BREEDING METHODS

1969 Annual Report of W-1

and

Report of

Annual Meeting of Technical Committee

May 8 and 9, 1969
Miles City, Montana

RECEIVED
CURRENT SERIAL RECORDS

MAY 31 1971

U.S.D.A.
RECEIVED

This report is intended for the use of administrative leaders
and workers and is NOT for general distribution

1969
Annual Report of W-1
and
Report of
Annual Meeting of Technical Committee

Miles City, Montana

May 8 and 9, 1969

CONTENTS

Agenda	i
Personnel	ii
Welcome	1
O. F. Pahnish, Superintendent	
U. S. Range Livestock Experiment Station	
Milk Protein Research	2
A. M. El Negoumy, Associate Professor, Montana State University	
U. S. Meat Animal Research Center, Clay Center, Nebraska	11
Keith E. Gregory, Director	
Station Reports	
Arizona	28
California - Bovine muscular hypertrophy	33
California - Heterotic effects	39
Colorado	40
Colorado - Lipid project	47
Hawaii	67
Idaho	73
Montana	76
U. S. Range Livestock Experiment Station	84
Nevada	102
New Mexico	107
Oregon	111
Utah	121
Washington	124
Wyoming	127
Project Reports and Discussion	131
Project Revision	163
Termination Comments:	
Robert L. Blackwell, Chairman W-1 Committee	166
Martin J. Burris, Acting Administrative Adviser	169
Carl F. Gierk, Assistant Administrator, C.S.R.S.	173
Business Meeting:	
Comments:	
Robert L. Blackwell, Chairman W-1 Committee	184
Will T. Butts, Jr., S-10 Coordinator	184
Larry V. Cundiff, NC-1 Coordinator	185
Paul A. Putnam, Chief Beef Cattle Research Branch	193
New and Old Business	194

AGENDA

W-1 Technical Committee Meeting

U. S. Range Livestock Experiment Station
Miles City, Montana
May 8 and 9, 1959

Dr. Robert L. Blackwell, Chairman

Thursday

8:15 A.M. Welcome

Dr. O. F. Pahnish, Superintendent
U. S. Range Livestock Experiment Station

8:45 A.M. Station Reports

Arizona, California, Colorado (2), Hawaii, Idaho,
Montana (2), U. S. Range Livestock Experiment
Station, Nevada, New Mexico, Oregon, Utah,
Washington, and Wyoming

1:30 P.M. Milk Protein Research

Dr. A. M. El Negoumy, Associate Professor
Animal and Range Sciences, Montana State
University

2:30 P.M. Clay Center

Dr. K. E. Gregory, Director
U. S. Meat Animal Research Center

3:30 P.M. Business Meeting

Comments:

Dr. M. J. Burris, Acting Administrative Adviser, W-1
Dr. P. A. Putnam, Chief, Beef Cattle Research Branch
Dr. C. F. Sierk, Cooperative State Research Service
Dr. L. V. Cundiff, NC-1 Investigations Leader
Dr. Will T. Butts, S-10 Investigations Leader

Friday

8:15 A.M. Business Meeting continued

Tour of U. S. Range Livestock Experiment Station
Projects

PERSONNEL

Project Leaders

Carl B. Roubicek*	Arizona
Kenneth A. Wagnon**	California
J. S. Brinks*	Colorado
E. H. Cobb*	Hawaii
R. E. Christian*	Idaho
R. L. Blackwell* (Chairman)	Montana
C. M. Bailey*	Nevada
L. A. Holland*	New Mexico
Ralph Bogart*	Oregon
J. A. Bennett*	Utah
C. C. O'Mary*	Washington
G. E. Nelms*	Wyoming
O. F. Pahnish*	U.S. Range Livestock Experiment Station

Administrative Adviser

Martin J. Burris***	Montana
---------------------	---------

Agricultural Research Service

Bradford W. Knapp	Acting Investigations Leader
Paul A. Putnam	Chief, Beef Cattle Research Branch

Cooperative State Research Service

Carl F. Sierk	Assistant Administrator
---------------	-------------------------

Guests Present

Keith E. Gregory	U.S. Meat Animal Research Center
Will T. Butts	S-10 Investigations Leader
Larry V. Cundiff	NC-1 Investigations Leader
David A. Cramer	Colorado State University
Diedrich Reimer	University of Hawaii
Milton A. Madsen	Utah State University
A. M. El Negoumy	Montana State University
P. J. Burfening	Montana State University
W. C. Windecker	North Montana Branch Station
P. O. Stratton	University of Wyoming
Calin Kaltenbach	University of Wyoming
Paul Caldwell	University of Wyoming
J. J. Urick	U.S. Range Livestock Experiment Station
Robert A. Bellows	U.S. Range Livestock Experiment Station
Robert Short	U.S. Range Livestock Experiment Station
Tom Riley	U.S. Range Livestock Experiment Station
Ron Gibson	U.S. Range Livestock Experiment Station

*Voting members

**Representing W. C. Rollins

***Representing J. H. Meyer, Administrative Adviser, W-1

W-1 TECHNICAL COMMITTEE MEETING

U. S. Range Livestock Experiment Station
Miles City, Montana
May 8 and 9, 1969

Dr. Robert L. Blackwell, Chairman

The W-1 Technical Committee convened at 8:15 A.M. in the Banquet Room of the Met Cafe. The meeting was called to order by the chairman, Dr. Blackwell, who introduced Dr. O. F. Pahnish, Superintendent of the U. S. Range Livestock Experiment Station.

Dr. Pahnish:

It is our pleasure to have you with us and we hope that your stay here will be a pleasant one. We will have a field trip tomorrow and most of my comments concerning the station will be taken care of at that time. I might just mention at the present time that the Station was originally a military reservation started back in the 1870's. It consisted of a block of land 10 miles square. It was taken over by the Department of Agriculture by an Act of Congress in 1924 and became an Experiment Station at that time. It consists of about 55,000 acres at the present time. Our total personnel at the Station number about 32-33 permanent employees. Our work is cooperative between the U. S. Department of Agriculture and Montana State Experiment Station. Our research staff consists of Federal employees. Most of the others are State employees. The livestock as you know is State owned; but the buildings, land, and fixed facilities are Federally owned and maintained. We will make other comments as we go into the field trip tomorrow.

Dr. Blackwell:

Our first guest speaker is Dr. El Negoumy who is a biochemist interested in food science. He is currently working with milk protein and other aspects of milk as it affects processing stability. He has developed some techniques which may be of interest to you. Dr. El Negoumy completed his PhD at the University of Wisconsin in 1951. He returned to Egypt for a few years to work; then he came to Ohio State University to do post doctorate work. He remained there for a period from 1958-1962, at which time he came to Montana State University and has been working there in the Department of Animal and Range Science since that time.

MILK PROTEIN RESEARCH
AT
MONTANA STATE UNIVERSITY

A. M. El Negoumy
Associate Professor of Agricultural Biochemistry
Montana State University, Bozeman

I am pleased to have this opportunity to discuss and review with you some recent advances in milk protein research, together with some of the work we are doing at Montana State University in this area.

Many of the problems encountered during milk processing revolve around the extent of the stability of its proteins, especially its caseinate fraction which is subject to coagulation by heat, freezing, high salt concentrations, acids and enzymes like rennin. The instability of milk proteins is the cause of substantial financial losses every year to milk producers, food processors and distributors. Solutions to this problem are being actively sought in many laboratories across this country and throughout the world.

The proteins of cows' milk account for an average of about 3.5-4.0 of its fluid composition. About 3% represent the caseinate fraction, while about 0.75% represent the whey or milk serum proteins. Casein can be removed from milk in 2 ways: (1) adjusting the pH of the milk to 4.60, which is the iso-electric point of casein, by addition of an acid or the growth of acid producing microorganisms. This is the basic method used for preparing casein industrially or for research, as well as in the manufacture of cottage cheese. (2) Coagulation through enzyme action (e.g. curd formation by rennin during cheese making). This casein retains its colloiddally bound calcium and phosphate, while acid casein is salt free.

When casein is examined by Tiselins' technique of free boundary electrophoresis it shows three components, α -, β -, and γ -caseins, in the order of reduced mobility. When the technique of starch gel electrophoresis is applied, at least 40 components are shown, indicating the great complexity of this protein. In 1959, Waugh and Von-Hippel, at M.I.T., fractionated the α -casein component into two main fractions: (1) called the calcium sensitive or α_s -casein, (2) called the calcium insensitive or κ -casein. The α_s -casein, if present alone in solution, precipitates immediately upon addition of calcium ions. However, if κ -casein is added to this solution at a certain ratio the α_s -casein remains in colloidal suspension after addition of calcium. In other words, κ -casein acts as a protective colloid which stabilizes α_s -casein.

The whey left after removal of casein contain the whey or milk serum proteins which represent about 0.50-0.70% of liquid whey. The β -lactoglobulin is represented by 0.30%, while the α -lactalbumin represents about 0.12%. The balance represents a mixture of minor

proteins, of which the blood leakage proteins, serum albumin and γ -globulins are the most important.

The interactions involved in the caseinate system:

It is now well established that casein components interact amongst themselves, as well as with the ionic atmosphere surrounding them to form large particles called caseinate micelles. These interactions are extremely involved and complex in nature. We now realize that our understanding of the mechanisms involved is barely in the embryonic stage. The most important advance in this area was made by Waugh and Von-Hippel at M.I.T. These workers fractionated the naturally occurring caseinate micelle into various fractions containing various proportions of α_{s1} -, β -, and κ -caseins. Brunner and others found the monomeric units of each of these casein components to have a molecular weight in the vicinity of 25,000. Waugh and Von-Hippel isolated a stable α_{s1} - κ -casein complex in which 4 α_{s1} -casein interacted with 1 κ -casein. Zittle at Beltsville and work in our laboratory showed the most stable complex of this kind to contain 10 α_{s1} -casein to 1 κ -casein. Since calcium ions lend additional stability to this complex, they are thought to form salt bridges between them and the phosphate groups on α_{s1} -casein. When the naturally occurring α_{s1} - κ -casein complex is attacked by the enzyme rennin, the κ -casein is disrupted and eventually hydrolyzed. This destroys its protective action on the rest of the micelle and consequently the whole complex coagulates in the form of a coagulum (curd). Work in our laboratory and at M.I.T. has also shown the α_{s1} - κ - complex to interact with β -casein to form micelles. Our results also showed that γ -casein is calcium insensitive like κ -casein, but it does not play any important role in the stability of the caseinate micelle.

Phenotyping of milk proteins:

Now I would like to discuss with you the subject of phenotyping of milk proteins. Prior to 1939, casein was thought of as a homogenous protein representing one entity. Mellander (1939) showed this concept to be wrong through the application of free boundary electrophoresis, which revealed casein to be composed of α -, β - and γ -components. The introduction of the starch gel technique by Smithies in 1955 opened a new field of research in proteins generally and in milk proteins in particular, concerning the mode of their inheritance. The application of the original Smithies technique to milk proteins showed them as smears on the gel with no resolution of components. This is evidently caused by the strong interaction between these components and their migration in complex formation. Wake and Baldwin (1960) at Wisconsin improved the technique considerably by adding high concentrations of urea (8M) to the gel to dissociate the milk protein components and prevent them from interacting. Their technique however, proved to be difficult to perform and lacked reproducibility (only 1 analysis out of 10 or so gave acceptable resolution in our laboratory). The starch gel techniques and the

equipment used in performing it were subjected to a rather extensive investigation in our laboratory for 2 years. As a result we now have a technique with superior resolution and excellent reproducibility. We also designed and built a new electrophoretic migration chamber which standardized electrophoretic conditions and simplified the process of gel preparation. These techniques have been published in Analytical Biochem. and in the Journal of Chromatog., listed in the last page of the hand-out material.

The application of electrophoresis in solid gels together with the refinement in the techniques of fractionation and purification of milk proteins, made the discovery of polymorphism or genetic variant in milk protein components possible.

Aschaffenberg was the first to report β -lactoglobulin to occur in 2 genetic variants, β -lactoglobulins A and B in order of decreasing mobility. These 2 variants proved to be alleles of an autosomal gene and occur either singly in the milk of homozygotes or in pairs in the milk of heterozygotes. A 3rd variant, β -lactoglobulin C, was discovered by Bell (1962) in the individual cow's milk of Australian Jersey breed. This particular variant proved to be very rare.

In 1954, Thompson and his associates at the U.S.D.A. Laboratory in Philadelphia found the α_{s1} -component of α_s -casein to occur in 3 variants - α_{s1} A or B or C in order of decreasing mobility. Family studies proved these variants to be controlled by 3 allelic autosomal genes with no dominance. Each of these alleles is responsible for one variant. These variants occur in individual cow's milk either singly or in pairs. The 6 possible phenotypes are α_{s1} A, α_{s1} B, α_{s1} C, α_{s1} AB, α_{s1} AC and α_{s1} BC. The data presented in the first table of the hand-out material indicates the distribution of the various phenotypes of α_{s1} -casein in four breeds of dairy cattle and in cross-breeds of beef cattle obtained from the Miles City Station. The predominance of phenotype α_{s1} B is evident. It is also apparent that phenotype α_{s1} A is very rare (only 1 sample out of 270 samples of Holstein milk contained it). Phenotype α_{s1} BC and variant C seem to be more common in Guernsey's milk than in the other breeds and cross-breeds.

In 1961, Aschaffenberg in England reported β -casein to occur in three variants, A,B,C, in the order of decreasing mobility. Here also we have 6 possible phenotypes, β A, β B, β C, β AB, β AC, β BC. The frequency of the various phenotypes found by us in the milk of 4 breeds of dairy cattle and in cross breeds of cattle from Miles City is reported in the 2nd Table in the handout material. It is evident from this data that phenotype β A and variant A are predominant over other variants. Aschaffenberg found variant "C" in the milk of British Brown Swiss. We have not detected any phenotype β C in our studies.

Neelin (1964) at Canada reported κ -casein to occur in 2 variants κA and κB , which occurred in the milk of individual cows either singly or in pairs. The 3rd Table on page 2 of the hand-out material indicate the frequency of occurrence of the 3 possible phenotypes κA , κB and κAB in four breeds of dairy cattle and in beef cattle from Miles City. As indicated, phenotype κA is predominant in three dairy breeds, Ayrshire, Guernsey and Holstein, while phenotype κAB was predominant in Brown Swiss and the milk from beef cattle.

The micelle composition of the milk from beef cattle is presented in the second half of page 2 of the hand-out material. The most prevalent micelles are composed of $\alpha_{s1}B+\beta A+\beta A$. Micelles of the composition $\alpha_{s1}B+\beta AB+\beta AB$ and $\alpha_{s1}B+\beta A+\beta AB$, each represented about 20% of the samples. The rarest micelle compositions were those composed of $\alpha_{s1}BC+\beta AB+\beta A$ and $\alpha_{s1}C+\beta A+\beta AB$.

The significance of genetic variants in milk proteins:

Our interest in the genetic variants of milk protein components is both applied and academic in nature.

From an applied point of view, the three variants of β -lactoglobulin were found to be very similar in amino acid composition, with each containing two identical chains of amino acids with only very minor differences between the variants (e.g., variant C differed from B, only in that one molecule of glycine replaces one molecule of glutamic acid). In spite of this overall similarity, these variants differ very markedly in the manner of their crystal formation and other physical properties. It is highly expected that variants of casein components will also show large differences in their patterns of interactions. Other protein systems which undergo polymorphism have already shown that (e.g. the replacement of single amino acid in normal human hemoglobin by glutamic acid) produces the sickle cell variant which leads to certain death.

For a long time many phenomenon observed in the behavior of milk proteins remained unexplained. One example is the significant differences in the clot forming properties of apparently similar milks when treated by the enzyme rennin. These behavioral differences are most likely explainable in terms of the structural differences of milk protein variants.

From an academic standpoint, the genetic variants of milk proteins should be of interest to the geneticist, the biochemist and to those who are interested in finding the origin of our cattle breeds.

Now, I would like to show a few slides to illustrate what we have been able to accomplish in this area of research at Montana State University.

Slides 1,2: Show the parts and the assemble unit of the migration chamber we used which was designed by us and constructed at Montana State University's Instrument Service Shop.

Slide 3: Represent electropherograms of whole casein using the gel composition and technique of Wake and Baldwin. Note the spreading of the electrophoretic zones which results in poor resolution. Note also that κ -casein did not resolve and that it is represented by a smear.

Slide 4: The same sample of whole casein shown in slide 3 electrophorized by our technique and equipment. The superiority of the resolution of all the components and their variants is self evident. This is especially noticeable in the κ - and γ -casein components.

Slide 5: Shows several samples of purified κ -caseins isolated and purified by a technique developed in our laboratory. As shown, each of the fractions contain 6 to 8 bands. Notice that KA and KB occur in all samples, but with noticeable differences in the intensity (concentration) of the bands. Recently we have demonstrated in our lab (unpublished work) that KA could be resolved into 2 components instead of one by varying the electrophoretic conditions.

Slide 6: Shows the γ -casein components and their variants. Normally the components in this fraction appear very lightly if all in patterns of whole casein. This is because of its low initial concentration coupled with its poor dye binding capacity. We have devised a rapid technique for preparation and purification of γ -casein and also achieved better dye binding capacity by modifying the staining technique. Five components are present in this fraction, named γ_1 , γ_2 , γ_3 , γ_4 and γ_5 , γ_1 , γ_2 and γ_4 each occur in two variants, A and B, either singly or in pairs, while γ_3 , γ_5 occur singly. γ_5 is positively charged in an alkaline buffer and consequently moves in an opposite direction to the other components.

Slide 7: We have recently isolated a very minor fraction of casein called Lambda-casein. This fraction has mobility faster than that of α_{s1} -casein. As seen in the slide, this fraction is heavily contaminated with other casein components.

Slide 8: Show the Lambda-casein fraction after purification with a new and unpublished technique of preparative electrophoresis. This slide also includes samples of α_{s1} -casein purified by preparative electrophoresis. (This is unpublished work.)

Slide 9: Shows 6 patterns of whole casein, the 1st represents untreated casein, casein treated for 5, 10, 15, 20 and 30 minutes respectively is shown in the next 5 patterns. Notice that κ -casein was the only component hydrolyzed, while the other components remained intact.

Slide 10: Shows purified κ -casein fraction treated with rennin for 50 minutes. Note the extensive breakdown and hydrolysis resulting in a multitude of breakdown products.

Slide 11: Represent α_s -casein treated with rennin for 3 hours. Until this work was done by us, two schools of thought existed. One claimed that rennin does not attack α_s - or β -casein, while the others believed the opposite to be true. It is evident that the α_{s1} -component of α_s -casein was hydrolyzed into two breakdown products with faster mobility.

Slide 12: Shows the extensive breakdown taking place in β -casein after 3 hours of rennin action.

Slide 13: Shows several samples of whole whey or whole serum proteins. Note variants A and B representing β -lactoglobulin; α -lactalbumin is represented by only 1 variant in the Western breeds, although 2 variants A,B were found in the humped (Zebu) cattle. Note that the euglobulin and pseudoglobulin components also include some variants which are yet unnamed. The preparation of whole whey protein, which is quite laborious, was simplified in our laboratory by dialysis of whole whey, followed by preevaporation or concentration of 1/4th the original volume. The proteins are then precipitated and washed with acetone.

Slide 14: This slide represents whole serum protein and their fractions and components prepared in our laboratory, e.g. crystalline α -lactalbumin, crystalline β -lactoglobulin, crystalline serum albumin (Note that these crystalline preparations are slightly contaminated with other components, indicating that crystallization of proteins is not a criteria of purity.). Note that euglobulin and pseudoglobulins are qualitatively but not quantitatively similar in electrophoretic composition.

Before I conclude my discussion I have one final remark. All the research work, previously conducted on milk protein stability (in the past 50 years) was made on protein fractions of questionable purity because of the lack of technique to ascertain purity, such as we have today. Also, this research was mostly done on milk pooled from single herds or many herds. These studies would have to be repeated in the light of the genetic variants of milk protein components.

HAND-OUT MATERIAL
MILK PROTEIN RESEARCH
AT
MONTANA STATE UNIVERSITY

Genetic Variants of α_{s1} -casein

Breed	No. Samples	α_{s1} Types & Combinations					
		A	B	C	AB	AC	BC
Ayrshire	44	0	44	0	0	0	0
Brown Swiss	20	0	19	0	1	0	0
Guernsey	80	0	38	5	0	0	36
Holstein	270	1	206	0	43	3	17
Beef Cattle- Miles City	241	0	205	1	1	0	34

Genetic Variants of β -casein

Breed	No. Samples	β -casein Types					
		A	B	C	AB	AC	BC
Ayrshire	44	44	0	0	0	0	0
Brown Swiss	20	11	2	0	6	1	0
Guernsey	80	74	0	0	2	4	0
Holstein	270	252	0	0	18	0	0
Beef Cattle- Miles City	241	173	2	0	57	1	8

Genetic Variants of κ -casein

Breed	No. Samples	κ -casein Types		
		KA	KB	KAB
Ayrshire	44	28	2	14
Brown Swiss	20	5	3	12
Guernsey	80	45	6	29
Holstein	270	194	10	66
Beef Cattle- Miles City	241	78	14	149

Combinations in casein from the milk of 241 individual beef cows:

<u>Combination</u>	<u>%</u>
$\alpha_{s1}^F + BA + KA$	41
$\alpha_{s1}^F + \beta AB + KAB$	22
$\alpha_{s1}^F + BA + KAB$	19.8

The other combinations accounted for 18.2%: The rarest combinations being:

$\alpha_{s1}^{BC} + \beta AB + KA$	0.40
$\alpha_{s1}^C + \beta A + KAB$	0.40

PUBLICATIONS IN THE AREA OF MILK PROTEIN RESEARCH FROM
MONTANA STATE UNIVERSITY

- El-Negoumy, A. M. Lability of sulfur in casein peptized with sodium hydroxide. J. Dairy Sci., 47:958 (1964).
- El-Negoumy, A. M. Effect of method of preparing I. E. Casein on its electrophoretic properties. J. Dairy Sci. 46:768 (1963).
- El-Negoumy, A. M. Physical and flavor stability of frozen milk dialyzed against simulated ultrafilterates. J. Dairy Sci. 48:23 (1965).
- El-Negoumy, A. M. Interaction of α_s -casein with κ -casein in model systems. J. Dairy Sci. 49:1478 (1966).
- El-Negoumy, A. M. A urea extraction technique for preparation of whole α_s - and β -caseins. J. Dairy Sci. 49:1461 (1966).
- El-Negoumy, A. M. Rapid recovery, preservation and phenotyping of milk proteins by a starch gel technique of superior resolving power. Analytical Biochem. 15:437 (1966).
- El-Negoumy, A. M. A convenient migration chamber for electrophoresis in solid gels. J. Chromatography 23:325 (1966).
- El-Negoumy, A. M. Polymorphism in γ -casein fractions from the milk of individual cows. Biochimica Biophysica Acta 140:503 (1957).
- El-Negoumy, A. M. Starch gel electrophoresis of products of action of crystalline rennin on casein and its components. J. Dairy Sci. 51:1013 (1968).
- El-Negoumy, A. M. Effect of various phenotypes of casein on the calcium caseinate micelle stability. J. Dairy Sci. 51:946 (1968) (Abstract).

U. S. MEAT ANIMAL RESEARCH CENTER
CLAY CENTER, NEBRASKA

Keith E. Gregory, Director

Research activities and contract construction have started at the U. S. Meat Animal Research Center. The emphasis in development, however, currently remains in the operations area, in converting the approximately 35,000 acres of land into a research installation and building livestock facilities and inventory.

The Research Center is being developed by the Animal Husbandry Research Division of the Agricultural Research Service, U. S. Department of Agriculture. Other Research Divisions that will have programs at the Research Center include the Agricultural Engineering Research Division and the Market Quality Research Division.

The research program is cooperative with the University of Nebraska Agricultural Experiment Station and with other Land Grant University Agricultural Experiment Stations. The research program is being designed to complement existing research conducted elsewhere by the U. S. Department of Agriculture and the State Agricultural Experiment Stations, and to extend investigations into new areas not now being adequately studied.

Research will involve basic and applied programs with beef cattle, sheep, and swine, and will be designed to obtain information relating to more efficient meat animal production and improvement in meat quality or desirability.

The Animal Husbandry Research Division's studies will involve genetics and breeding, physiology and biochemistry of growth, reproduction, fattening, feed utilization, carcass traits, and other production factors. The work of the Agricultural Engineering Research Division will be oriented toward engineering factors that influence livestock production. Activities of the Market Quality Research Division will be aimed at identifying and evaluating factors that influence meat quality or palatability.

The development of facilities is planned in two stages, referred to as Phase I and Phase II. Phase I, now underway, will provide for part of the animal husbandry research. Phase II will provide additional facilities for animal husbandry research and will provide for livestock engineering and market quality research.

The Phase I construction contract was awarded to Penner Construction Company, Denver, Colorado. It is anticipated that Phase I will be completed in June of 1970. An office-laboratory building and a limited number of animal buildings are included in this construction.

The 1968 Agricultural Appropriations Bill included funds for planning Phase II of the facility in addition to funds for continuing the land and associated resource development programs. Planning of Phase II facilities is now in progress.

The U. S. Department of Agriculture and State staff at the Research Center may total 300 or more persons, including 67 scientists and appropriate administrative and technical support personnel. While a limited number of scientific staff have been hired, most of the scientific staff will not be recruited for approximately one and one-half years, or until appropriate laboratory and office facilities have been developed, and the land and associated resources developed to carry the experimental livestock populations. Plans are to complete staffing at the presently planned level by 1973.

The immediate major staffing requirements for the Research Center are for operations personnel to develop the land and associated resources, and to manage the livestock populations.

To date, approximately 8,000 acres have been seeded to warm season pastures and approximately 14,000 acres have been seeded to cool season pastures. It is planned to seed an additional 1,600 acres to warm season pasture in the spring of 1969.

In addition to seeding pastures, the current development program involves the construction of fences, livestock watering facilities, and livestock handling facilities. Much use is made of equipment and material acquired from the excess or surplus of other governmental agencies.

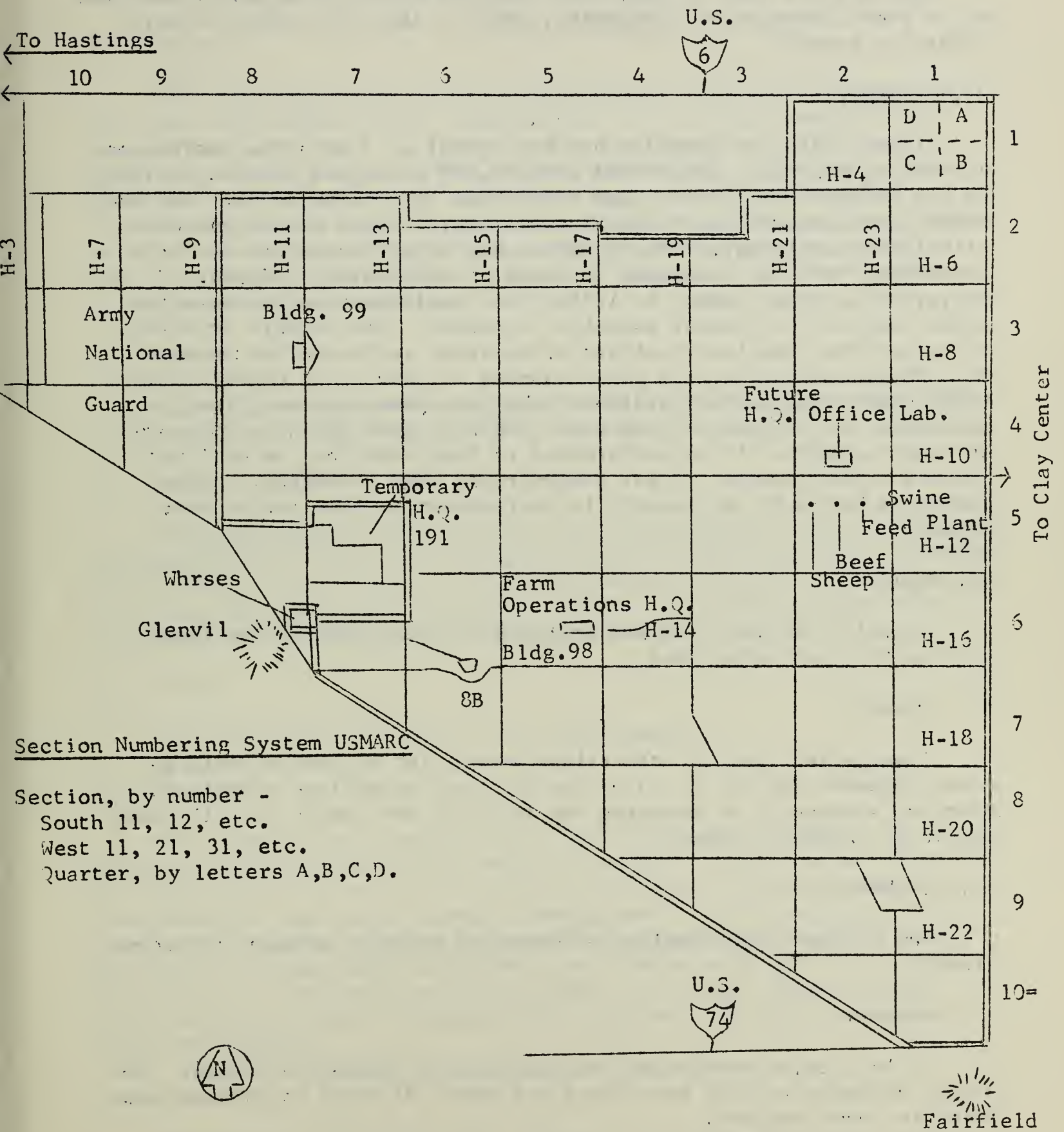
Limited research has been initiated at the Research Center. The research in progress at the Research Center is basically of a short-term nature that can be conducted with limited personnel and facilities.

The two long-term breeding experiments in progress at the Fort Robinson Beef Cattle Research Station, Crawford, Nebraska, will be transferred to the Research Center as soon as adequate pastures and facilities are developed to meet their special requirements.

Present livestock inventory at the Research Center includes approximately 3,000 sheep. Some of these were transferred from the Southwestern Range Sheep Experiment Station, Fort Wingate, New Mexico. Approximately 5,000 cattle are now on the Research Center.

The following page provides a map of the Research Center and indicates the location of the temporary headquarters, as well as the site where the permanent headquarters is being constructed.

U.S. MEAT ANIMAL RESEARCH CENTER
CLAY CENTER, NEBRASKA



Discussion

Dr. Holland:

Why did you tear up good farm land and put it into grass? Looking at it from a production standpoint, does it look like there is more forage in grass?

Dr. Gregory:

There isn't any question but the animal is a relative inefficient harvesting machine. Confronted with 35,000 acres and limited capital, we had to get a relatively high percentage of it into grass. Our cool season pastures will last from 8 to 10 years. Warm season pastures will last much longer. This land has an irrigation potential for a tremendous vertical expansion in terms of feed units produced. We do anticipate a great amount of irrigation development to increase the animal capacity if animal capacity is needed. The numbers necessary to answer the questions that are being asked is the optimum number of animals consistent with the resources to carry that number. While those aren't the maximum yielders, they are good yielders from the standpoint of TDN per unit of land. We will grow 350 acres of corn and some sorghum. It is anticipated in long term that we will not produce a great amount of our concentrated feed resources. We do expect to have a lot of animals in confinement in this performance program.

Dr. Holland:

Actually pasture land and irrigated pasture land is the least efficient way of using land.

Dr. Gregory:

Twenty-five tons of corn silage means a lot of gain or maintenance, however you use it in cattle or sheep operations doesn't it? From the standpoint of managing the facility your point is well taken and it is in the picture.

Dr. Blackwell:

How big was your sampling of breeding programs between different areas?

Dr. Gregory:

It is a cross section of the pedigrees of these two breeds. The number of herds - 18 of each breed and about 60 sires roughly of each breed in round numbers.

Dr. Brinks:

Although you don't have all of your staff and all of your plans for the future experimental designs, could you elaborate a little more on general areas and possible scopes of these?

Dr. Gregory:

The areas that will get primary attention and this is consistent with the long range study: reproduction in all three species, meat aspects involving both quantitative and qualitative in all three species, and the full spectrum of feed efficiency in the life cycle. There will be other problem areas that will be given attention; for instances, the inputs by the agricultural engineering group. The market quality group will be restricted to the meats area, and the waste management area will get attention because it is the one that is number one in many offices.

Dr. Brinks:

I was thinking specifically about beef cattle. If you had 3000 cows, would you have these allotted to specific projects?

Dr. Gregory:

We have budgeted 2000 cows for this germ plasma evaluation program with cattle right now. We are emphasizing the need to stay as flexible as we possibly can and on a continuing basis to be able to make plans on things that are happening right now that will have a major effect on what we should be doing 5 years from now.

Dr. Brinks:

How many cows do you have in crossbreeding?

Dr. Gregory:

Of course, this is part of our total heterosis program. We would evaluate the ones that show promise in regard to their potential in straightbred or potential in systematic crossing programs as well as the potential use in new breeding developments to the extent that we can. In the design of this we do plan on continuing into F-3's and making backcrosses among the populations where we do not have female populations to evaluate heterosis effect and recombination effects which relate to kinds of crossbreeding systems and potential of new breed development.

Dr. Holland:

Could you go back over what breeds are involved in this crossbreeding?

Dr. Gregory:

In this germ plasma evaluation?

Dr. Holland:

Yes.

Dr. Gregory:

Hereford-Angus females.

Dr. Holland:

Is that straight Hereford and straight Angus?

Dr. Gregory:

Yes, this is what we would call Part One of Cycle One, Hereford-Angus males, Jersey, South Devon, Simmental, Limousin, and Charolais. The Limousin is contingent upon the bulls now in quarantine producing good semen and it being ready to cross the border early in July. There are five bulls in foreign quarantine of the Limousin breed that will be available commercially in July. There are five Simmental bulls available commercially. As far as being available commercially, it hasn't been put on the market but a sizeable South Devon importation has been made as some of you undoubtedly are aware. This is the source of sampling this spring: Charolais, both French and Domestic, Hereford and Angus, sampling young sires from both studs. We are not using progeny tested bulls in this program.

Dr. Holland:

What are the ages of your females?

Dr. Gregory:

One, two, three and four.

Dr. Holland:

Were they picked up from industry?

Dr. Gregory:

Yes, about 1800 females will be bred in this program this year. We will add new breeds perhaps the Red Polled, perhaps the Brown Swiss, or others that may come on the scene.

Dr. Brinks:

The largest breeding project would have 2000 cows wrapped up in this for 1, 2, and 3 cycles?

Dr. Gregory:

This is where you have to stay flexible. To finish Cycle 1 requires about 8 years, but Cycle 2 would be coming in starting in 3 years.

Dr. Holland:

Have you already made some matings?

Dr. Gregory:

We will mate them starting in June.

Dr. Bogart:

What are you going to breed the crossbred heifers to?

Dr. Gregory:

Part of four breeds (Hereford, Angus, Charolais, and Simmental) will be bred either straight, backcrossed, or production of unselected F-1, F-2, F-3 interstate matings from the base population in order to evaluate recombination and heterotic effects. The remainder of them would include the Hereford-Angus crosses, the Jersey-Hereford, and Jersey-Angus. These would be crossed to bulls of the third breed of the bull spectrum, primarily bulls that may show the greatest potential as sire breeds for specialized crossbreeding systems.

Dr. Holland:

Did I understand you to say that you were going to use crossbred bulls?

Dr. Gregory:

This is in the segment more concerned with heterotic and recombination effects. We will use crossbred bulls, crossbred females, interstate matings throughout F-3's.

Dr. Burris:

I understand there is an advisory committee set up for this station.

Dr. Gregory:

There is an advisory committee. We have had one meeting, we will meet again in September of this year. It is composed of administrative and scientific personnel from USDA and State Agricultural Experiment Stations and it also has industry representation.

Dr. Burris:

Is this exclusive of the Western Region? Is there anyone in there from the Western Region?

Dr. Gregory:

From the Western Region there is a nutritionist from California, Dr. Lofgreen. This is a rotating committee of approximately 3-year terms and new people will be added.

Dr. Burris:

This is your advisory committee?

Dr. Gregory:

This is the Meat Animal Research Center Advisory Committee. It is being set up as an Advisory Committee to the Department of Agriculture for the Meat Animal Research Center.

Dr. Burris:

Do you pick them?

Dr. Gregory:

They are picked by the Secretary's Office.

Dr. Burris:

They don't represent any segment, in other words, the American National Cattlemen doesn't have a representative on it?

Dr. Gregory:

Not as a commodity group, we do have two industry people whose primary interests are beef cattle who are members of the American National Cattlemen Association.

Dr. Burris:

But are they people you picked?

Dr. Gregory:

This is correct, we do not ask them to designate a member.

Question:

How large is your committee?

Dr. Gregory:

It is about twenty-five. It will be expanded some to take care of the market quality interests and the agriculture engineering interests as they evolve. This is a large committee; we figured this committee would function mainly by subcommittee action on a continuing basis. As projects start developing, they will be referred to the appropriate interests of that committee for review.

Dr. Putnam:

It might be worth pointing out, that the recommendation of the original committee did include a member of the W-1 committee. Somehow, inadvertently, this did not get processed all the way through.

Dr. Gregory:

We expect it to be a working committee. If the committee cannot make recommendations that influence priorities, then it is not a functional committee. We fully expect this committee to make recommendations that will effect priority structure relating to problem areas and program development. We feel that we have a committee here where the industry interests are given attention and the scientific interests are represented both from the State Station and USDA standpoint. Working on a subcommittee basis as far as activities are concerned, we should be able to get real effective council relating to problems. The committee will overall function in providing council that would help in assigning priorities to programs. Dollars are limited and even if dollars were not limited, in a facility as large as we have, there are many things that we can't do. Obviously our objective is to zero in on what we can do that isn't being done and can't be done elsewhere. It is not restricted to that, but basically we think the facility can function by making that kind of contribution.

Dr. Bogart:

I wanted to commend you on this type of approach. I think the State Stations because of the nature and the size of their herds are going to have to do intensive studies with the animals, and you can do the part of what might be called extensive studies.

Dr. Gregory:

In my opinion we would be remiss if we didn't do both. In other words if we have these populations and can get an understanding of some component of beef cattle biology, then obviously it is incumbent that we do so.

Dr. Bogart:

What I mean is, you aren't just setting up a whole barrage of little studies where you could have large numbers.

Dr. Gregory:

Yes.

Dr. Roubicek:

Just what will be your working relationship with the University of Nebraska, and what arrangements are going to be made for graduate student programs or programs that would be related to state cooperative students or staff members there? Are we ever going to be related directly with the work there?

Dr. Gregory:

We have this potential if we want to do it, by we I mean you and us. In regard to the University of Nebraska, administratively the animals regardless of what funds were used to purchase them (Federal or State) are transferred to the University of Nebraska. Receipts go back into that program. Thus there is a close administrative relationship with the University. Obviously because of geography, there is and will continue to be a close relationship from the standpoint of programs. The relationship between the Meat Animal Research Center, the University of Nebraska, and any other Land Grant University is the same from the standpoint of program. We are interested in cooperating in the broadest spectrum. This involves an exchange of scientific personnel. We will have people from our staff going elsewhere where the program there is consistent with our charge, and where it can be done more effectively at the other location because of the personnel and the physical plant resources. Likewise, people from state stations have the same opportunity to come and be with us for a period. Whether we have an extensive extramural program to provide or to facilitate this kind of cooperation is dependent on the funding. In other words the mechanism is there, we are interested in doing it, and we think it is to our mutual interest in servicing our respective charges to do so. We hope the funding evolves so that it can be done at an effective level.

Mr. Windecker:

Will you have some disease control in the research or will it be just preventative?

Dr. Gregory:

Basically preventative, we do have and will increase liaison with the National Animal Disease Laboratory. If they have problems we can work with relating to management factors associated with disease control, we would have an interest in doing so. Certainly early postnatal mortality comes in the area of reproduction.

Dr. Bellows:

You mentioned that half of the Station would be taken up with cattle, one-fourth sheep, and one-fourth swine. What are the total numbers as we look at the capacity?

Dr. Gregory:

Whatever numbers that are needed to answer the problems consistent with the ability of our resources to carry them and our resources to fund the programs. Certainly with very little irrigation development we can carry 5000 breeding-age cattle, 10,000 breeding-age sheep, and we are thinking in terms of 500 litters of pigs per year. Again it depends on the pertinence of the questions.

Dr. Bellows:

You mentioned that you are approaching this from the interdisciplinary approach when you tie these programs together. What about programs of experimental surgery and things of this kind where these animals would be manipulated in such a way that it would be a little difficult to make an interdisciplinary approach on it. How will priorities be put on this?

Dr. Gregory:

There may be other interests that would be involved. There may be that specific type of activity. Certainly the kinds of activities will vary in regard to the importance and necessity of interdisciplinary approaches. Reproduction, feed efficiency, meat aspects all have interdisciplinary approaches. As specific units of that get broken down, specialized surgery might relate to anatomy as it relates to meat and to reproduction, etc. This would be a unit of the synchronized program, but a facet of that in which one discipline may be involved or more than one discipline may be involved, but it would still relate to a total program.

Dr. Short:

How is it set up administratively? What is the Clay Center relationship to the Beef Cattle Research Branch or the Swine Research Branch? How is it funded?

Dr. Gregory:

We have one program in each of the three species or the Animal Husbandry Research Division which is our operation unit. Joint planning on a reciprocal basis for programs between the Branches and the Meat Animal Research Center relates to program development for the Division for these three species. All funds are appropriated to the Division and the Division allots the funds to the Branch, to the U. S. Meat Animal Research Center, or to the various branches of the Meat Animal Research Center.

Dr. Short:

Then funds for beef cattle research would be channeled through the Beef Cattle Research Division?

Dr. Putnam:

The Director's office under Dr. Hodgson is broken down into Assistant Directors' offices. Dr. Warwick is the Assistant Director responsible for the meat animal research program. He in essence will be coordinating the effort in the meat animal research area which in this instance would be beef cattle at our Field Station in Beltsville and our Meat Animal Research Center at Clay Center. His office will respond to suggestions and inputs from the respective kinds of organizations and will have the primary responsibility in relation to the distribution effort at the division level.

Dr. Gregory:

Organizationally we have a Dairy Research Branch, a Poultry Research Branch, Beef, Sheep, Pigs, and Meat Animal Research Branches. These are all involved in programs for the Animal Husbandry Research Division. Joint planning involving the units as far as allotment of funds is done at the Animal Husbandry Research Division Director level.

Mr. Knapp:

When I was back in Beltsville in March talking to Dr. Cundiff, he indicated that you might possibly assign a staff member to the North Central, Southern, and Western Region committees and they would have a contributing part in the committee.

Dr. Gregory:

We would be interested in making our efforts there contribute to all regional projects if regional projects develop. We are interested in the joint planning aspects that can evolve from the kind of deliberation that we have had in our regional beef cattle type of committees involving reciprocal relationships relating to joint planning and exchange of information. We would be interested in making our efforts contribute to whatever committee evolves from this transition, and would like to be represented on whatever committee is set up.

Dr. Putnam:

There is one beef program in the country. The Federal effort wants to contribute its share along with the State Experiment Stations through Agriculture Field Stations, the Meat Animal Research Center, and however we can cooperate to the best mutual advantage of everyone involved.

Dr. Gregory:

We are interested in W-1 or whatever W-1's successor may be in regard to how our efforts may contribute and enjoy the advantages that come from joint planning and idea exchanges.

Dr. Putnam:

Not only is W-1 in transition; but the entire animal research effort, the development of the U.S. Meat Animal Research Center, and the development of the rest of the beef cattle effort is essentially in a process of transition both from the standpoint of other regions and from the standpoint of the development of the programs for the future.

Dr. O'Mary:

Do you have an anticipated level of staffing for this at the present time?

Dr. Gregory:

Yes, animal husbandry efforts, Phase One and Two, has 47 scientists, 8 agricultural engineering scientists, and 12 market quality scientists. Phase Three which relates to forage, production, harvesting, handling, and utilization programs has 12 scientists in crop research and 8 scientists in agricultural engineering. This would be a total of 87 scientists for the three phases. Support personnel again is flexible but would be in the neighborhood of 250 to 300.

In regard to our organizational structure at the Center, we have an administrative unit which includes personnel, fiscal, supply, and a full range administrative services. We have an operations unit which involves cattle operations, sheep operations, swine operations, farm and maintenance operations, and meat research operations. These are staffed by professional animal husbandrymen down to the operation assistant level to manage livestock, fiscal plant, land and livestock facilities programs. Our scientific objective is to provide as much as possible the mechanics of operation to minimize the scientists' time requirement, and have some plan ahead for investigations units in genetics of breeding, reproduction, energy metabolism, nutrition, and meats.

Dr. O'Mary:

In the cattle area where you are doing crossbreeding and studying several breeds, do you anticipate using the same cattle for other studies, such as management, nutrition problems, and this sort of thing or are you going to limit it to beef cattle breeding?

Dr. Gregory:

Characterizing these populations in regard to reproduction, in regard to nutrient requirements, in regard to meat characteristics, etc. is very much a part of it. Beyond that there are also variations.

Dr. Holland:

I was wondering why you as an x-regional coordinator who developed inbred lines didn't start some topcrossing at Clay Center? Why did you go to crossbreeding rather than evaluate the existing lines?

Dr. Gregory:

What are our objectives in evaluating existing lines?

Dr. Holland:

Do they have any use? All regions have expended a lot of man hours and dollars in the formation of these lines then they are discarded before they are ever used or are used in a very limited way technically.

Dr. Gregory:

If we found they differed, what conclusions could we draw?

Dr. Holland:

Are they useful in any program? The intent in the formation of these lines in the beginning was that it be used in a systematic topcrossing program.

Dr. Burris:

I thought it was the intent that we could develop some outstanding lines of cattle that could perform well on their own merit.

Dr. Gregory:

Was our interest more in developing germ plasm for the industry to use or in developing methodology?

Dr. Holland:

We never really carried this out, we never really tested the methodology. We formed a lot of lines then we suddenly started discarding them.

Dr. Cundiff:

It is also the segregation between lines. In other words in inbreeding you take the whole average when you start it from the population and divide it into a bunch of sub-populations and produce a bunch of inbred lines. What is the expectation in topcross performance at the end? I think the whole expectation in the whole selection is where you started from, that is, your method of selection plus where you started from. I think what you are suggesting is that in a topcross evaluation you can find there are two to three lines after the third methodology of work. This is the problem that you are pointing to that they have a lot more lines. What is the efficiency of this in assisting the industry?

Dr. Bogart:

I think if we make these tests we might learn a lot about why certain lines of breeding are not combining well, or what is the mechanism involved. It might save us making the same mistakes in crossbreeding; I don't think all of your crossbreeding is going to be successful either.

Dr. Gregory:

The development of inbred lines implies the utilization of nonadditive genetic variations in systematic topcrossing rotating among lines.

Dr. Brinks:

The response to selection is due to a change in genes. It speeds up the response of change of genes.

Dr. Gregory:

This involves selection among lines between lines. In selection within lines your additive and nonadditive genetic variation is reduced.

Dr. Brinks:

What you can do is speed up this change. Certainly there is some reduced variation, but you are fixing major genes that have a big effect on growth, reproduction, etc. Looking at our own inbred lines, we have inbred lines for a lot of reproductive semen quality which are much better and more consistent than straight outbred calves, which indicates to me that there are a few major genes that are doing something. With these interdisciplinary studies we can learn a lot by utilizing the animals we have developed.

Dr. Gregory:

If I summarize it correctly, what we are concerned with is the kind of gene action we are involved with; and procedures for evaluating that are a little hard to get particularly in beef cattle. The primary concern is really evaluating the kinds of gene action in beef cattle. We have a sizeable additive genetic variation, we know how to use it to a certain extent, and we know we have a sizeable nonadditive which we can use in systematic breed crossing programs. Our interest in these new breeds is a means of a more rapid rate of changing gene frequency than we can do by selecting within our existing stocks, in optimizing whatever trait in stocks we are concerned with. As far as breaking down the kind of gene action, Dr. Cochran has spent years at the computer and the corn people have planted thousands of acres of corn; and do you think they have their questions in perspective yet? I am just wondering if we shouldn't spend some time to see if we can't crystalize our questions or answer them with a little greater precision relative to this. Priorities must be assigned and maximum input is a basis for assigning these priorities.

Dr. Holland:

In your opinion will crossbreeding be the most productive of these?

Dr. Gregory:

Yes, I would have to say by action that it is.

Dr. Cobb:

I think a more appropriate question is, what assumption did you make in regard to gene action when you set up the crossbreeding program?

Dr. Gregory:

The question was how important is nonadditive genetic variation in populations of beef cattle.

Dr. Brinks:

Is there any thinking of doing any genetic environmental interaction studies on a national scale or on a location basis?

Dr. Gregory:

We are concerned with genetic environmental interactions. When we look at the range of feed environments that we have and will likely have to produce feed, then we must ask ourselves the question of the importance of genetic environmental interaction particularly as it relates to feed or nutrition variables. We do plan to have feed variables in these populations.

Dr. Brinks:

We wouldn't have the inbred lines, but I think to make this on a national scale is more important than just varying feed.

Dr. Gregory:

Certainly there are other aspects to environment than feed. Utilizing the feed resources that we have available is the question that we are asking. What is the best unit type in different situations and different program objectives? We would like to extend our program to consider this. Obviously in this initial screening and testing, some material is going to be better than others for different types of situations. What you are eluding to, Dr. Brinks, is how do we move beyond that into a second cycle involving other locations.

Dr. Bailey:

Would this include State cooperation as well?

Dr. Gregory:

There is no reason why it couldn't.

Dr. Bailey:

In this exchange of ideas and plans are you also saying now that this would include the exchange of germ plasm?

Dr. Gregory:

In connection with this we do plan to have an activity in germ plasm storage. Helping to service mutual interests for each cooperation is the route that we must travel and germ plasm exchange is one facet of it.

S T A T I O N R E P O R T S

UNIVERSITY OF ARIZONA

- I. Station: Arizona Agricultural Experiment Station
- II. Project title: 1. Breeding and selection of beef cattle for the Southwest. 2. Progeny testing of selected Hereford sires.
- III. Personnel:
- Experiment Station:
C. B. Roubicek, Project Leader, L. W. Dewhirst, A. M. Lane,
D. E. Ray, and B. R. Taylor
- U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado
Bradford W. Knapp, Acting Investigations Leader
- IV. Nature and extent of work done this year:
1. The Western Directors made contingency funds available to continue feedlot test of bull progeny.
 2. Evaluation of blood constituent data is continuing.
- V. Summary of progress:

Table 1. Heritability estimates of blood constituents in unsupplemented range cattle

Age (days)	H^2	Creatinine		H^2	Uric acid	
			SE			SE
235	0.06		0.06	0.04		0.05
340	0.01		0.03	0.06		0.06
600	0.00		0.03	0.07		0.06
710	(a)		0.03	0.14		0.09

(a) Negative estimate of sire variance.

VI. Publications and manuscripts:

Taylor, R. L., O. F. Pahnish and C. B. Roubicek. 1968. Hepatic and blood concentrations of carotene and vitamin A in unsupplemented range cattle. J. Animal Sci. 27:1477-1486.

Roubicek, C. B., R. L. Taylor, O. F. Pahnish and D. E. Ray. 1968. Plasma phosphorus and blood hemoglobin concentrations in unsupplemented range cattle. J. Animal Sci. 27:1487-1493.

VII. Project summary:

Arizona Agricultural Experiment Station

Cattle Inventory - June 30, 1958

Breed	Hereford
Purebred or grade	Purebred
Bulls (12 months or over)	152
Cows (2 years or over)	476
Heifers (yearlings)	140
Calves - bulls	132
steers	0
heifers	167

Cow Production Data - 1958 calf crop

Number of cows bred to calve:	
As 3-yr.-olds and up	476
Number of calves born - alive	389
- dead	2
Cows died at parturition	0
Calves weaned	383
Percent calf crop - born	81.7
- weaned	80.5

Prewaning Performance - 1958 calf crop

	Bulls	Heifers
Birth weight	74	71
Weaning age	247	246
Weaning weight - lb.	458	422
Weaning score:		
Conformation	11	11
Condition	11	11

Sire Summary - 140 day test

Sire	N	ADG
094 U. A. 325	6	2.89
103 Nevada 684	4	2.89
113 New Mexico 512	8	3.15
114 Wyoming 74	5 (4)	3.09
115 Bozeman 347	9 (8)	3.26
116 Nevada K413	4	2.99
117 MC 4536 (L14)	6	3.34
118 MC 3199 (L4)	6	3.56
119 Utah 113C	6	2.94
120 Nevada 716	6	2.90
121 Colorado 5410 (Brae Arden)	9	3.46
122 Colorado 4578 (Royal)	6	3.27
Overall mean		3.17

Arizona Agricultural Experiment Station

140 Day Test Results

<u>Tattoo</u>	<u>DOB</u>	<u>Initial Wt.</u>	<u>Final Wt.</u>	<u>ADG</u>	<u>Conf. Score</u>	<u>Cond. Score</u>
<u>094</u> U.A. 325						
840	044	510	918	2.91	10	14
8120	054	428	810	2.73	10	13
8170	059	496	908	2.94	11	12
8195	063	530	972	3.16	12	13
8216	064	426	780	2.53	10	11
8256	067	490	918	3.06	10	14
		480	884	2.89		
<u>103</u> Nevada 684						
883	051	510	884	2.67	11	12
8124	054	440	822	2.73	10	12
8140	058	416	894	3.41	10	12
8162	059	438	820	2.73	10	12
		451	855	2.89		
<u>113</u> New Mexico 512						
8158	059	502	990	3.49	12	12
8188	060	386	724	2.41	9	9
8221	064	518	946	3.06	12	12
8240	066	424	910	3.47	10	12
8266	070	458	976	3.70	12	12
8335	096	476	936	3.29	12	12
8370	122	344	686	2.44	10	11
8379	129	380	850	3.36	10	13
		436	877	3.15		
<u>114</u> Wyoming 74						
891	051	432	890	3.27	11	13
8206	063	450	830	2.71	10	12
8218	064	366	Died			
8230	066	484	966	3.44	11	12
8291	077	406	812	2.90	10	12
		443	875	3.09		

Arizona Agricultural Experiment Station

<u>140 Day Test Results</u>						
<u>Tattoo</u>	<u>DOB</u>	<u>Initial Wt.</u>	<u>Final Wt.</u>	<u>ADG</u>	<u>Conf. Score</u>	<u>Cond. Score</u>
<u>115</u> Bozeman 347						
892	051	446	896	3.21	12	12
8152	059	558	1004	3.19	12	13
8153	059	590	1032	3.16	11	12
8189	061	422	846	3.03	11	9
8190	061	448	914	3.33	11	11
8199	063	456	970	3.57	11	13
8215	064	456	908	3.23	11	12
8233	066	504	966	3.30	11	11
8238	066	428	Died			
		485	942	3.26		
<u>116</u> Nevada K413						
8114	053	440	864	3.03	10	13
8302	079	446	786	2.43	10	12
8349	108	390	874	3.46	10	13
8356	113	430	858	3.06	10	13
		427	846	2.99		
<u>117</u> MC 4536(L14)						
844	045	490	884	2.81	11	12
8213	064	500	980	3.43	12	13
8214	064	496	1016	3.71	13	12
8222	064	450	886	3.11	12	12
8274	072	412	930	3.70	12	12
8319	085	442	898	3.26	11	12
		465	932	3.34		
<u>118</u> MC 3199(L4)						
859	047	472	946	3.39	11	11
866	050	420	944	3.74	11	13
885	051	406	850	3.17	10	12
8285	077	442	960	3.70	11	13
8339	100	406	944	3.84	11	12
8389	145	396	894	3.56	11	11
		424	923	3.56		

Arizona Agricultural Experiment Station

140 Day Test Results

<u>Tattoo</u>	<u>DOB</u>	<u>Initial Wt.</u>	<u>Final Wt.</u>	<u>ADG</u>	<u>Conf. Score</u>	<u>Cond. Score</u>
<u>119</u> Utah 113C						
855	047	488	924	3.11	12	12
8149	059	450	860	2.93	11	12
8186	060	376	766	2.79	10	12
8220	064	402	850	3.20	11	12
8275	072	426	874	3.20	11	12
8386	137	392	730	2.41	10	10
		422	834	2.94		
<u>120</u> Nevada 716						
854	047	440	812	2.66	10	12
863	050	470	856	2.76	11	12
8150	059	464	872	2.91	12	11
8196	063	394	834	3.14	10	12
8223	064	474	910	3.11	10	14
8235	066	458	852	2.81	11	13
		450	856	2.90		
<u>121</u> Colorado 5410 (Brae Arden)						
873	050	522	1062	3.86	13	12
8157	059	390	814	3.03	11	12
8179	060	486	964	3.41	11	13
8193	061	538	1092	3.96	13	13
8262	068	476	918	3.16	11	12
8288	077	484	924	3.14	12	12
8317	085	432	948	3.69	11	12
8325	087	512	1018	3.61	12	12
8385	137	510	970	3.29	13	12
		483	968	3.46		
<u>122</u> Colorado 4578 (Royal)						
842	044	498	922	3.03	11	12
889	051	448	954	3.61	10	11
8203	063	464	888	3.03	11	11
8264	070	458	938	3.43	11	12
8276	074	456	920	3.31	11	13
8378	129	404	858	3.24	10	12
		455	913	3.27		

Conformation and condition score: 10 = low choice. 12 = high choice.

UNIVERSITY OF CALIFORNIA

- I. Station: California Agricultural Experiment Station
- II. Project title: Bovine muscular hypertrophy - a study of its inheritance and an investigation of its usefulness to the beef industry (Project 2477).
- III. Personnel:
- Experiment Station:
W. C. Rollins, Project Leader, L. M. Julian, Moira Tanaka,
and K. A. Wagnon
- U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado
Bradford W. Knapp, Acting Investigations Leader
- IV. and V. Nature and extent of work done this year and summary of progress and conclusions to date:

Testing of the meat index (M.I.) and identification phenotype (I.P.) is being continued. Data from the slaughter of the 13 bulls and 13 heifer calves of a m⁺ Charolais bull in January 1968 are being analyzed. The chemical analysis of the carcasses of the latter animals is being completed. M.I. and I.P. data are currently being collected on other animals for further testing.

A method of studying the pelvic tilt and its relationship to hindquarter musculature is being experimented. In this method, the tuber ischii (pin bone) and tuber coxae (hip bone) of the animal are marked by spraying a dot of paint contrasting the animal's coat color on the point; then the animal is led in front of a grid and his photograph is taken while he is standing in a square position.

Thirty-four cattle have been purchased from four separate lines of Angus cattle. Of these 34, 33 are females, 31 have complete pedigrees available, 9 are mm, 12 are m⁺ (proven by progeny test) and the remaining 13 are closely related to the latter, but not of proven genotype.

The spring of 1968 calvings produced 3 mm, 4 m⁺ (proven by parentage) and 41 m⁺ or ++ calves. The surplus bull calves of this crop were sold leaving 10 of which three (one mm, one m⁺ and one ++, all grandsons of one bull and all one year of age at slaughter) were sacrificed in April 1969 for complete carcass data, muscle dissection and chemical carcass analysis. (See attached Bovine Slaughter and Dissection Data sheet, revised 4-15-69). Analysis of this data is not yet complete, but Table 1 shows some interesting early results on the three. M.I., I.P. photographs with grid and extensive body measurements (see attached Body Measurements and Observations Sheet) had been taken on the three bulls.

The 1968 heifers are being used to study the relationship between onset of puberty and musculature. Also complete body measurements, M.I. data, I.P. data and photographs (with grid and marked tuber ischii and tuber coxae) are taken on these animals in an effort to separate the m+ from the ++.

In 1968 the cow herd was bred by one mm red Angus bull (by natural service and A.I.), one m+ Angus bull (A.I.) and one ++ Shorthorn bull (natural service). Calvings began in late March and will continue through July. Of the calves produced, about half are taken from the dams at one day of age and are bucket fed for controlled postnatal maternal environment. These calves are weighed, photographed and carefully observed at birth with notes made on muscular bulge locations (with respect to under-lying muscles); routine M.I. data, I.P. data, pelvic tilt data and body measurement data will be collected on these calves.

Plans are being completed for this summer's matings which will be entirely A.I. using two mm bulls and one ++ bull. From these matings we can expect:

	mm	m+	++
Angus	20	23	14
Hereford	-	5	5
Shorthorn	-	2	3
Crossbreds	1	5	5

Various investigators are working on the following problems:

- a. Growth and development
- b. Onset of puberty in relation to development of musculature
- c. Nutritional studies
- d. Metabolism studies
- e. Muscle enzymes
- f. Carcass analysis
- g. Parturition
- h. Anatomical variations
- i. Breeding

VI. Application of findings:

Too early to report.

VII. Work planned for the future:

To continue according to previous listed plans.

VIII. Publications and manuscripts:

Rollins, W. C., L. M. Julian and F. D. Carroll. 1969. A note on the body composition of a double-muscled female and a normal female from a linebred Aberdeen Angus herd. Animal Prod. 11(1):111-114.

Table 1. Early results of M.I. and slaughter data from three yearling bulls

Genotype	mm	m+	++
Age	367 days	359 days	359 days
M.I.			
Rump gage score	.5	3.5	4.0
GM rating	1.75	2.5	3.5
Dressing %	63.8	57.3	56.8
Wt. of dissected muscles from hindquarter*	13,462 gm	11,235 gm	9,320 gm

*Corrected for a 300 lb. carcass.

IX. Project summary:

California Agricultural Experiment Station

Cattle Inventory*

	Yearlings			Two years and over two years		
	Bull	Steer	Female	Bull	Steer	Female
<u>++:</u>						
BA						14
(BA) (H)						5
(BA) (S)						4
H						10
S						4
<u>++ or m+:**</u>						
BA	2		14			22
AS	3		2			
AH	1		6			
A (AH)			1			
<u>+m:***</u>						
BA			2	1		16
H						1
RA				1****		
RA (H)						1
<u>mm:</u>						
BA	3		6	1	1	5
(BA) (H)			1	-	-	-
C			-	1	-	1
RA				1		

*BA = Black Angus, H = Hereford, S = Shorthorn, RA = Red Angus, C = Charolais.

Breed of sire shown first.

**From MH lines but not of proven genotype.

***On basis of progeny test or having one mm parent.

****Loan bull.

Note: Calving is in progress.

Bovine Slaughter and Dissection Data

Project 2477

Slaughter Group _____ Slaughter Date _____
Animal Number _____ Sex _____ Breed _____
Dam _____ Sire _____ Birthdate _____
Project _____ Anatomy Number _____
Remarks _____

Slaughter Data (fresh weights)

Intact weight _____ Method and time of time _____
Weight**of blood(hot) _____ Weight of sample _____
Hot weight, right side _____ Left side _____ Tail _____
Hide weight _____ Head _____ Brain _____ Tongue _____
Weight, four feet _____ Weight, right rear foot _____
Weight, digestive tract full _____ Empty _____ Fill _____
Rumen complex _____ Intestinal tract _____ Rumen volume _____
Respiratory tree _____ Heart _____ Liver _____ Kidney _____
Mesenteric fat _____ Repro. tract _____ Pancreas, spleen, gall bladder _____

Dissection Data, Right Side (chilled weights)

Date and time _____ Rib eye area _____ Fat thickness _____ Marbling _____
Chilled weight in air _____ In H₂O, front _____ hind _____
Specific Gravity _____ Hours chill _____ Wt. RH foot _____ Ht. _____
Metatarsal, weight _____ length _____ circ. _____
Femur, weight _____ length _____ circ. _____
MUSCLE WTS.: Gracilis _____ Sartorius _____
semimembranosus _____ semitendinosus _____ biceps femoris _____
T. fascia latus and sup. gluteal _____ Gluteus medius _____
Profundus _____ Quadriceps group _____
Gastrocnemius _____ Soleus _____ S. & d. distal flexors _____
Long digital extensor _____ Extensor digitalis brevis _____
Trapezius _____ Triceps brachii _____ Biceps brachii _____
Sup. & deep digital flexor _____ Common digital extensor _____
Remarks _____

NOTE: SPECIFY UNITS ON ALL WEIGHTS!!!
INDICATE TARE, IF ANY, AND UNITS OF!

Animal: _____
 Birth date: _____
 Sex: _____
 Breed: _____

Body Measurements and Observations

(use reverse for comments)

Age group	Birth	1 mo.	4 mo.	8 mo.	12 mo.	16 mo.	20 mo.	24 mo.	30 mo.	36 mo.
Actual age:										
Date:										
Condition:										
Observer:										
Weight:										
Skin thickness:										
Cannon circumference:										
Chest girth:										
Paunch girth:										
Round:										
Over hip										
P to P:										
Across pelvis (TC-TC):										
Body length:										
Thigh:										
Height at knee:										
Height at elbow:										
Height at withers:										
Height at hips:										
Chest width:										
Chest depth:										
Loin width:										
Hips width:										
Width at pinbones:										
Pelvis length:										
Head length:										
Head width:										
Rump shape:										
Gluteus medius:										
Creases:										

- I. Station: California Agricultural Experiment Station
- II. Project title: Studies of heterotic effects in crosses of the Angus, Hereford and Shorthorn breeds (Project 1215).
- III. Personnel:

Experiment Station:

W. C. Rollins, Project Leader, F. D. Carroll,
Moira Tanaka, and K. A. Wagnon

- IV. and V. Nature and extent of work done this year and summary of progress and conclusions to date:

The experiment proceeded according to plan. At the Sierra Foothill Range birth of the third, and last, calf crop has been completed. Summation of data has been initiated.

- VI. Application of findings:

The results of this experiment will contribute, along with data gathered and being gathered at other experiment stations in the U.S.A., to precise estimates of the amount of hybrid vigor in crosses of the British beef breeds.

- VII. Work planned for the future:

None.

- VIII. Publications and manuscripts:

Rollins, W. C., R. G. Loy, F. D. Carroll and K. A. Wagnon. 1969.
Heterotic effects in reproduction and growth to weaning
in crosses of the Angus, Hereford and Shorthorn breeds.
J. Animal Sci. 28(4):431-436.

- IX. Project summary:

California Agricultural Experiment Station

Cattle Inventory*

	SA	SH	SS	S (SA)	S (SH)	S (SS)
Calves:						
Steers				6	3	1
Heifers						1
3-year old						
cows	6	3	2			
Bulls			1			

*A = Angus, H = Hereford, S = Shorthorn. Breed of sire shown first.

COLORADO STATE UNIVERSITY

- I. Station: Colorado Agricultural Experiment Station
- II. Project title: Comparisons of mating systems and mass selection in beef cattle production.
- III. Personnel:
 - Experiment Station:
 - J. S. Brinks, Project Leader, Peter Fagerlin, Russell Sutton, and James Olson
 - U. S. Department of Agriculture, Agricultural Research Service, Fort Collins, Colorado
 - Bradford W. Knapp, Acting Investigations Leader
- IV. Nature and extent of work done this year:

Calculation of inbreeding coefficient utilizing the computer was completed on all lines through the 1968 calf crop and the new calf card format was completed.

A comparison of steer progeny by Station bred sires with Colorado rancher progeny tested in the Coors Feedlot during 1967 and 1968 was completed. Progeny by 5 Station sires were evaluated and comparisons are shown in Table 1. The Station linecross progeny had heavier initial weights, gained more rapidly in the feedlot, and produced longer, heavier carcasses than other Herefords in the test. They also had less fat covering and percent kidney fat and had somewhat higher cutability percentages. However, they had lower marbling scores and in 1968 had lower carcass grades. The 2 Station progeny groups ranked 2nd and 4th in feedlot gain among the 30 herd or sire groups including all breeds and crossbreds in 1967. In 1968, the 3 progeny groups ranked 1st, 2nd, and 6th among 22 herd or sire groups in feedlot gain.

Weaning records of 4722 commercial Angus calves from 1501 dams and 9 years were analyzed to compare the efficiency and accuracy of correction factors computed from herd data (Method 1) as compared to factors recommended by the beef cattle industry (Method 2). Estimated repeatability of weaning weight computed as the intraclass correlation among calves of a cow was 0.251 and 0.247 from Methods 1 and 2, respectively. The correlation between the two adjusted records of an individual was 0.80. In general, it appeared that under commercial conditions the additional expense of computing correction terms specific for the herd is not justified.

A study on the effect of early, bunched calving in the optimum season on weaning weights of calves and lifetime production of cows was completed. Twenty years of data on the Station herd were used.

TABLE 1. Progeny Test Results by Sire and Year Groups

1966-67

Sire	No.	Initial Final		Av. Daily	Carcass		Fat	Kidney		Ribeye		Marb. ¹	Car. ²	Percent ³
		Wt.	Wt.	Gain	Wt.	Length	Thick.	Fat	%	Area	Score	Gr.		
		lbs.	lbs.	lbs.	lbs.	in.	in.	in.		sq. in.				Cutability
Pros. 9022	3	540	1180	3.37	740	49.2	.48	.48	3.1	12.9	5.7	16.0	50.0	
Pros. 4425	5	553	1136	3.07	700	50.2	.37	.37	3.3	12.0	5.0	15.8	50.4	
CSU Average	8	548	1153	3.18	715	49.9	.41	.41	3.2	12.3	5.3	15.9	50.3	
All Herefords														
Except CSU	181	479	995	2.72	524	46.9	.52	.52	3.7	10.4	5.4	15.9	48.8	
Difference		59	157	.46	91	3.0	-.11	-.11	-.5	1.9	-.1	0	1.5	

1967-68

Tarr. 3098	4	566	1199	3.20	753	50.1	.38	.38	3.2	12.4	4.5	15.3	50.1	
Tarr. 3166	5	514	1104	2.98	695	48.8	.44	.44	3.3	12.0	4.6	15.4	49.8	
Pros. SJ 5472	5	534	1200	3.46	763	50.2	.56	.56	2.9	12.3	5.0	15.8	49.0	
CSU Average	14	535	1155	3.20	736	49.7	.46	.46	3.1	12.2	4.7	15.5	49.6	
All Herefords														
Except CSU	105	479	1039	2.83	664	47.0	.50	.50	3.3	11.0	5.4	15.9	49.1	
Difference		57	126	.37	72	2.7	-.04	-.04	-.2	1.2	-.7	-.4	.4	

¹Marbling score: 4 is slight amount, 5 is small amount, 5 is modest amount, etc.

²Carcass grade: 15 is high good, 16 is low choice, etc.

³Percent cutability is the estimated percent of trimmed, retail cuts from the round, loin, rib, and chuck. It is calculated from fat thickness, percent kidney fat, ribeye area, and carcass weight values.

Calves born the first 20 days of the calving season averaged 17 days earlier and 41 lbs. heavier than the overall herd average. Most of the weaning weight advantage of early calves was due to the older ages at weaning but calves born earlier in the season also gained faster from birth to weaning which also added to their advantage. Cows were also grouped into 20-day intervals by the date of birth of their first calf. Cows that calved during the first 20 days of the calving season the first time continued to calve somewhat earlier and wean heavier calves throughout life. They calved 12 days earlier and weaned calves averaging 20 lbs. more than herd average during their productive life.

The effects of differences among years, sex of calf, mating system, and sire of calf were determined for individual calf records on day of season of birth and weaning weight. All four factors were important in affecting weaning weights, whereas years, mating systems and sire of calf affected day of season of birth significantly. The individual calf records were adjusted for all four factors and averages were calculated for each dam. Several regression analyses were then performed using averages based on 4.7 calves per dam. The regression of average day of season of birth on day of season of birth of the first calf was 0.42 days, indicating that for every 10 days earlier a cow calved the first time, she would be expected to average 4.2 days earlier on all calves.

The regression of average weaning weight on day of season of birth of the first calf was minus .54 pounds indicating that dams calving 10 days earlier the first time should wean calves averaging 5.4 pounds heavier. For every 10 days earlier a dam's first calf was born, the total pounds produced per cow during her lifetime increased 32.4 pounds based on an average of 4.7 calves per cow. Regression coefficients of average day of season of birth and average weaning weight per dam on age of dam at first calving showed that heifers conceiving the soonest after 15 months of age weaned older and heavier calves throughout life. There was no indication of impairing a cow's lifetime production by breeding at younger ages but rather of actually improving production.

Environmental and genetic factors affecting cow productivity were studied using 22 years of data obtained from inbred and linecross Hereford cattle. Weaning weights of 2,285 calves were used to compute two Most Probable Producing Ability (MPPA) values for each of 600 cows. MPPA-1 was computed from weaning weights adjusted for sex, weaning age, age of dam and levels of cow and dam inbreeding. MPPA-2 was computed from weights adjusted for sex, weaning age and age of dam. Factors studied included cow birth year, age of dam, line of sire, line of sire of dam, actual weaning weight, weaning age, weaning score, cow inbreeding and dam inbreeding. Preliminary analysis indicated the two-way interactions did not have an important effect. Product moment correlations of MPPA-1

with actual weaning weight, weaning age and weaning score were 0.03, -.01, and -.07, respectively, and correlations of MPPA-2 with cow inbreeding and dam inbreeding levels were -.17 and 0.23, respectively. Least squares analysis indicated that cow birthyear, line of sire and cow inbreeding effects and both MPPA values were highly significant ($P < .01$). Age of dam and actual weaning weight effects on MPPA-1 were significant ($P < .05$). Cows from young and old dams had higher MPPA values than cows from five to eleven-year old dams. Cow birth year, age of dam, line of sire, line of sire of dam and residual accounted for 4.0, 1.6, 6.4, 0.2, and 87.8%, respectively, of the total variation of MPPA-1. Results indicated that environmental factors reflecting high preweaning levels of nutrition had a detrimental effect upon subsequent cow productivity.

V. & VI. Summary of progress and application of findings:

Linecrossing within a breed combined with performance testing and selection is an effective breeding program for producing superior cattle in rate of gain and carcass cutability.

Average weaning weights and lifetime production of cows can be increased by breeding heifers so they will calve early in the optimum season their first time.

Replacement heifers should not have an extremely high preweaning plane of nutrition since it could have a detrimental effect on future production.

VII. Work planned for the future:

The revised project outline will begin with the 1969 breeding season. Comparisons of linecrossing within breeds vs. crossbreeding with outbred parental stock vs. crossbreeding with inbred parental stock vs. mass selection in outbred stock will be initiated. The genetic and environmental relationship between maternal ability and growth potential will be examined.

VIII. Publications and manuscripts:

Brinks, J. S. 1969. Field Day Report. General Series 869, Colorado State University Experiment Station, Fort Collins, Colorado.

Fagerlin, Peter T. 1968. Aspects of calving interval. M.S. Thesis. Colorado State University Library, Fort Collins, Colorado.

Hohenboken, William D. 1968. Repeatability of weight in beef cattle. M.S. Thesis. Colorado State University Library, Fort Collins, Colorado.

Hohenboken, W. D. and J. S. Brinks. 1968. Effect of environmental corrections on repeatability of weaning weight in Angus. J. Animal Sci. 27:1126 (Abst.)

Morrow, D. L. 1968. Factors affecting beef cow production. M.S. Thesis, Colorado State University Library, Fort Collins, Colorado.

Richardson, Glenn L. 1968. Carcass merit of beef bulls and heifers. M.S. Thesis. Colorado State University Library, Fort Collins, Colorado.

IX. Project summary:

Colorado Agricultural Experiment Station

Cattle Inventory - June 1969					Total
Breed	Hereford			Angus	
Line	Inbred	Line-cross	Control		
Total number	238	271	34	63	606
Bulls (12 mos. or over)	37	2	1	1	41
Cows (2 yrs. or over)	101	126	16	15	258
Heifers (yearlings)	21	30	2	28	81
Calves - Bulls	28	61	6	10	105
- Heifers	51	52	9	9	121

Cow Production Data - 1968 calf crop				Total
Number cows bred to calve:				
As 2-yr.-olds	16	15	8	39
At 3 yrs. and up	97	147	19	263
Number calves born from:				
2-yr.-olds - Alive	14	14	2	30
- Dead	1	1	0	2
3-yr.-olds and up - Alive	76	113	16	205
- Dead	2	7	0	9
Number of calves weaned	79	115	18	212
Percent calf crop - Born	82.3	83.3	66.7	81.4
- Weaned	69.9	71.0	66.7	70.2

Prewaning Performance - 1968 calf crop				Average
Birth weight - Bulls	74	88	78	80
- Heifers	70	73	80	74.3
Weaning age - Males	208	214	224	215.3
- Heifers	207	216	213	212
Weaning weight - Males	408	465	453	442
- Heifers	356	437	419	404
Adjusted weaning weight* - Males	463	467	441	457
- Heifers	429	453	440	440.7
Weaning score:				
Conformation - Males	4.6	5.0	4.9	4.83
- Heifers	4.3	4.8	4.8	4.63
Average inbreeding - Males	39.5			
- Heifers	43.4			

*Adjusted weaning weight = calf weaning wt. + sex correction + age of dam correction + calf FX correction + dam FX correction + age correction to 205 days.

Colorado Agricultural Experiment Station

Postweaning Performance - 1968 calf crop				Total or Average
Breed	Hereford			
Line	Inbred	Linecross	Control	
Sex	Bull	Bull	Bull	
Method of feeding	Individual			
Number on test	25	40	5	70
Average age on test	243	242	259	248
Initial weight	455	505	535	502
Days on test	140	140	140	140
Average daily gain	2.42	2.52	2.71	2.58
Feed efficiency:				
Lbs. gain/100 lbs. TDN	7.60	7.32	7.04	7.32
Final weight	805	871	915	863.67
Final score:				
Conformation	3.9	4.1	4.4	4.13
Average inbreeding	39			

I. Station: Colorado Agricultural Experiment Station

II. Project title: The heritability of various components of serum lipids and their relationship to the composition and distribution of fat in beef cattle. (Project 28)

III. Personnel:

Experiment Station:

D. A. Cramer, B. E. Thrall, J. S. Brinks

U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado

Bradford W. Knapp, Acting Investigations Leader

IV. Nature and extent of work done this year:

Lipid classes (phospholipids, free fatty acids, glycerides, cholesterol and cholesterol esters) and the fatty acid compositions of the lipid classes have been quantitatively determined on blood serum, intramuscular fat and subcutaneous fat from 482 beef cattle representing nine western stations over a two-year period. Total serum lipid and percent intramuscular fat were also recorded on each animal.

Heritability estimates, genetic and phenotypic correlations, sex, station, sire and line differences have been computed and the results are reported in the attached tables.

V. Summary of progress and conclusions to date:

As may be noted in the attached tables, there are many interesting significant differences between sexes, stations, sires, and lines as determined by the analysis of variance. In addition, there are several serum lipid components that have heritability estimates of such a magnitude as to be useful in a selection program involved with studies on the composition and distribution of fats in beef cattle.

The significant correlations observed between types of lipids from the different tissues indicate that analysis of tissues such as blood serum can be utilized in estimating the amount and composition of lipids in other tissues.

VI. Application of findings:

This is the most complete set of data available on the composition of various types of lipids in cattle and will be very useful as background information for researchers working on the composition of animal fats.

The data also indicate that analysis of serum and other tissue lipids will be useful in selection for improvement of carcass quality.

VII. Work planned for the future:

As this is the final report of Project 28, the only work planned for the future as a contributing project to W-1 will be publication of the results of the data as reported herein.

VIII. Publications and manuscripts:

Thrall, Bernice E. 1969. Interrelations of beef cattle lipids. Ph.D. Thesis. Colorado State University, Fort Collins, Colorado (In preparation)

IX. Project summary:

Not applicable.

Table 1. Percentage Means and Standard Deviations of Blood Serum Phospholipid Fatty Acid Composition.

Means:		14:0	14:1	15:0	isol6	16:0	16:1	17:0	isol8	18:0	18:1	18:2	20:0
Acid	Stat. N												
1	24	1.2	0.6	0.6	1.1	20.8	2.8	4.9	0.7	33.2	24.2	7.4	1.3
2	18	0.9	0.7	0.8	0.4	21.3	2.5	3.7	0.4	38.6	19.4	8.4	0.0
3	95	0.9	0.4	0.7	0.6	21.7	2.8	2.8	0.9	37.5	15.6	14.9	0.6
4	26	1.3	0.6	1.5	1.0	23.6	3.7	4.6	1.2	37.0	16.3	7.1	1.0
6	7	0.6	0.2	0.6	1.2	23.2	1.4	1.9	0.5	37.2	17.0	14.8	0.1
7	62	1.8	0.2	0.4	0.3	22.4	3.1	1.4	0.4	31.7	23.4	14.1	0.4
9	52	0.9	0.4	0.6	0.5	21.2	2.2	2.9	0.6	36.7	19.2	14.0	0.3
12	19	0.6	0.7	0.4	1.0	18.9	3.2	2.0	0.9	40.2	18.6	11.5	0.8
14	69	0.8	0.4	0.8	0.8	22.7	3.5	2.4	0.6	37.7	21.8	8.0	0.2
Total $\bar{x}$:		1.0	0.5	0.7	0.8	21.8	2.8	3.0	0.7	36.7	19.5	11.2	0.5
Std.Dev.:													
Stat.													
1		1.7	0.9	0.4	1.5	3.8	1.9	4.3	1.0	6.7	5.9	4.4	2.1
2		0.8	0.8	1.7	0.4	3.0	1.6	2.5	0.4	4.8	3.6	6.2	0.2
3		0.8	0.6	0.4	0.6	3.7	1.2	1.5	0.9	5.8	4.1	8.9	1.3
4		1.4	0.7	1.7	0.6	5.7	1.7	1.9	1.3	7.2	4.9	5.9	2.6
6		0.2	0.1	0.1	0.5	2.1	1.2	0.6	0.3	6.5	2.8	6.0	0.2
7		2.4	0.3	0.4	0.3	5.0	1.8	1.2	0.5	8.6	8.3	7.5	0.7
9		0.6	0.4	0.3	0.6	4.9	1.3	2.4	0.5	7.4	6.2	8.0	0.5
12		0.3	0.5	0.3	1.1	2.4	1.6	1.1	0.8	4.4	3.3	5.3	0.7
14		0.4	0.4	0.5	0.6	3.2	1.4	1.3	0.5	3.4	3.0	4.5	0.7

Fatty acids are designated by chain length, : = number of double bonds. Fatty acids observed were C10 through C20. Stat = Station; 1 = U. of Hawaii, 2 = U. of California, 3 = San Juan Exp. Sta., 4 = Oregon State U., 6 = Montana State U., 7 = Miles City Exp. Sta., 9 = New Mexico State U., 12 = Washington State U., 14 = Havre Exp. Sta. N = number of animals.

Table 2. Percentage Means and Standard Deviations of Intramuscular Phospholipid Fatty Acid Composition.

Means:		<u>14:0</u>	<u>14:1</u>	<u>15:0</u>	<u>isot6</u>	<u>15:0</u>	<u>16:1</u>	<u>17:0</u>	<u>isot8</u>	<u>18:0</u>	<u>18:1</u>	<u>18:2</u>	<u>20:0</u>
Acid ---	Station												
	1	4.0	0.5	1.0	0.7	25.7	3.4	0.8	0.7	15.3	37.5	7.1	1.3
	2	3.0	0.8	0.5	1.4	26.2	4.1	1.0	1.1	15.5	34.1	9.5	1.1
	3	3.0	0.5	0.6	2.2	21.4	3.2	1.4	1.9	13.5	25.0	24.8	0.8
	4	1.0	0.5	0.5	4.1	23.6	3.3	0.8	3.5	11.7	32.5	15.9	2.1
	5	1.6	0.4	0.2	2.2	20.3	4.9	0.9	1.9	14.6	34.8	16.4	0.6
	7	2.3	0.4	0.8	1.9	19.9	4.6	1.3	2.0	17.0	30.6	17.3	1.4
	9	3.4	0.6	1.2	3.0	25.5	3.2	2.8	1.3	13.0	26.9	17.1	0.9
	12	2.3	0.4	0.7	2.0	21.4	3.4	1.4	1.8	12.7	30.9	20.9	1.5
	14	2.4	0.4	0.6	2.8	22.2	4.4	1.2	2.7	13.4	30.9	18.2	0.5
Total x:		2.6	0.5	0.7	2.2	22.9	3.8	1.3	1.9	14.1	31.6	16.4	1.2
Std.Dev.:													
Station													
1	1.6	0.5	1.0	0.7	4.8	1.3	0.5	0.4	3.1	4.3	3.2	3.2	1.5
2	2.1	0.8	0.5	1.7	3.3	1.6	0.7	1.0	2.7	3.9	3.9	5.2	1.1
3	3.1	0.6	1.0	2.5	3.7	1.1	1.5	1.9	3.9	5.5	5.5	7.2	0.9
4	1.5	0.5	0.7	2.6	6.5	1.9	0.9	1.7	4.2	5.8	5.8	5.3	1.5
5	0.9	0.4	0.1	1.5	2.4	1.2	0.3	0.8	3.0	7.5	7.5	7.4	0.2
7	2.4	0.4	1.0	2.1	4.9	2.9	1.7	2.0	4.4	5.2	5.2	7.1	1.8
9	3.1	0.6	1.6	3.4	6.9	2.2	3.7	1.9	4.2	5.9	5.9	7.2	1.2
12	2.3	0.7	1.2	2.2	3.8	1.7	1.3	1.8	2.3	3.5	3.5	4.4	1.0
14	2.7	0.4	2.3	2.7	4.8	1.3	1.3	2.1	2.8	4.9	4.9	5.9	0.6

Table 3. Percentage Means and Standard Deviations of Blood Serum Free Fatty Acid Composition.

Means:		14:0	14:1	15:0	isol5	15:0	16:1	17:0	isol3	18:0	18:1	19:0	20:0
Acid ---													
Station													
1		3.0	2.4	1.4	1.5	27.1	5.1	2.7	0.9	23.0	27.8	2.5	0.0
2		2.3	2.0	1.7	1.0	28.9	5.3	2.3	0.4	21.1	27.1	3.0	0.3
3		3.8	1.5	1.9	0.9	25.2	7.0	3.3	1.2	23.0	20.2	9.1	0.8
4		2.8	2.3	2.3	2.0	25.9	5.4	4.0	1.2	25.2	19.0	4.4	1.1
5		2.8	0.4	1.4	1.0	30.4	4.6	1.4	0.5	21.5	26.3	7.0	0.3
7		2.9	0.5	0.7	0.3	25.3	4.8	1.7	0.3	24.9	30.1	5.7	0.5
9		3.1	1.3	1.7	1.0	26.5	5.2	3.9	1.0	21.8	24.1	7.8	0.3
12		2.7	2.1	1.2	2.6	27.4	7.0	1.5	1.7	22.4	20.3	5.6	2.2
14		3.2	1.7	1.8	0.8	24.3	7.3	3.5	1.0	24.4	25.5	5.3	0.3
Total x:		3.0	1.6	1.5	1.2	27.0	5.0	2.7	0.9	23.0	24.7	5.7	0.7
Std.Dev.:													
Station													
1		1.2	2.3	1.5	2.4	3.5	2.5	3.2	1.4	4.4	5.8	2.0	1.0
2		1.2	1.7	2.7	1.3	3.3	2.5	2.4	0.5	5.7	5.8	2.2	0.5
3		1.6	1.1	0.9	1.4	4.9	2.9	1.6	1.6	4.5	4.7	4.8	1.8
4		1.5	2.0	1.7	1.6	4.0	2.6	2.1	1.3	5.8	4.6	5.5	1.2
6		0.6	0.3	0.3	0.6	3.5	1.4	1.1	0.4	2.8	6.1	3.1	0.4
7		3.7	0.6	0.7	0.4	4.3	1.9	2.0	0.6	5.5	7.2	3.4	0.7
9		1.2	1.3	1.3	1.2	4.7	3.3	2.8	1.4	5.2	5.4	0.5	0.7
12		1.7	1.2	1.2	2.1	4.8	2.7	1.6	1.7	6.0	5.3	4.4	2.7
14		1.0	1.0	1.0	1.0	3.3	3.0	2.2	1.4	3.5	4.2	3.3	0.8

Table 4. Percentage Means and Standard Deviations of Intramuscular Free Fatty Acid Composition.

Means:		<u>14:0</u>	<u>14:1</u>	<u>15:0</u>	<u>iso15</u>	<u>15:0</u>	<u>16:1</u>	<u>17:0</u>	<u>iso18</u>	<u>18:0</u>	<u>18:1</u>	<u>18:2</u>	<u>20:0</u>
Acid ---													
Station													
1		2.9	1.0	1.5	1.2	30.1	4.0	2.1	0.5	18.7	33.0	2.0	0.4
2		4.0	0.8	1.3	0.5	27.3	4.6	1.5	0.7	19.1	34.7	1.9	0.7
3		2.6	0.6	0.5	0.2	27.6	4.8	1.5	0.8	19.1	34.6	6.8	0.5
4		1.6	0.7	0.8	1.5	29.5	4.1	1.2	1.4	18.9	33.8	3.7	1.2
6		3.1	0.6	0.3	0.1	24.0	5.9	1.1	0.9	17.2	42.3	3.8	0.4
7		2.3	0.6	0.6	0.2	27.5	5.2	1.9	0.9	19.0	34.6	6.0	0.7
9		2.5	1.1	1.0	0.8	29.0	5.2	2.6	1.3	17.2	29.9	5.6	1.5
12		2.0	1.2	1.5	0.8	29.1	5.4	1.9	1.1	18.0	33.7	2.7	1.6
14		2.5	0.7	0.6	0.2	25.8	5.1	1.6	1.4	18.9	38.2	3.4	0.6
Total x:		2.6	0.8	0.9	0.5	27.8	4.9	1.7	1.0	18.4	35.0	4.1	0.9
Std.Dev.:													
Station													
1		1.2	1.1	1.9	1.9	3.9	1.7	1.7	0.7	2.6	5.3	1.4	0.7
2		2.2	1.0	2.0	0.9	4.5	2.0	1.4	0.8	4.2	4.5	1.1	0.9
3		1.0	0.5	0.4	0.8	5.4	1.9	1.1	1.6	4.4	4.7	5.2	1.2
4		0.8	0.5	0.8	1.8	4.4	2.7	1.4	1.3	3.5	4.6	2.5	1.2
6		1.7	0.4	0.3	0.1	5.4	2.8	0.7	0.5	4.8	7.5	1.9	0.4
7		0.9	0.7	0.8	0.3	4.6	1.9	1.9	1.5	5.8	4.9	3.8	1.9
9		1.7	1.7	1.1	1.6	6.0	3.1	2.4	2.8	3.7	5.1	4.6	2.4
12		0.8	1.2	1.9	2.0	4.4	3.7	1.6	1.7	3.3	7.1	1.2	3.1
14		1.5	0.7	0.4	0.3	4.5	1.8	1.2	2.6	3.2	5.9	1.8	1.4

Table 5. Percentage Means and Standard Deviations of Blood Serum Triglyceride Fatty Acid Composition.

<u>Means:</u>		<u>14:0</u>	<u>14:1</u>	<u>15:0</u>	<u>isol6</u>	<u>16:0</u>	<u>16:1</u>	<u>17:0</u>	<u>isol8</u>	<u>18:0</u>	<u>18:1</u>	<u>18:2</u>	<u>20:0</u>
<u>Acid ---</u>													
<u>Station</u>													
1		3.1	2.0	1.5	1.7	29.7	5.3	2.8	0.4	23.7	24.9	2.0	0.5
2		2.2	2.1	1.4	0.9	26.9	4.2	1.9	0.4	19.4	22.5	11.5	0.9
3		3.2	1.7	1.8	0.7	25.3	5.6	2.5	1.0	25.5	23.9	0.0	0.5
4		3.1	2.5	2.7	1.5	25.1	5.7	2.4	1.2	25.7	22.0	4.5	0.8
6		3.1	0.7	1.1	0.9	31.6	4.0	2.0	0.5	30.4	20.1	4.6	0.3
7		3.4	0.7	0.8	0.3	25.1	4.9	1.5	0.6	23.2	28.4	9.4	0.7
9		2.7	0.9	1.5	0.8	27.4	4.8	2.7	0.8	22.7	27.1	6.7	0.7
12		1.5	1.5	1.0	1.9	26.4	5.2	1.2	0.9	32.1	23.4	2.6	1.3
14		2.8	1.8	1.5	0.7	26.2	5.8	2.4	0.6	29.9	24.2	3.2	0.2
Total $\bar{x}$:		2.8	1.5	1.3	1.0	27.1	5.0	2.2	0.7	26.0	24.0	5.6	0.7
<u>Std.Dev.:</u>													
<u>Station</u>													
1		1.1	1.4	1.9	2.0	4.5	2.2	2.6	0.6	5.7	5.7	1.7	0.9
2		1.2	1.2	1.4	0.9	5.8	1.6	1.3	0.3	7.5	5.7	16.7	2.5
3		1.0	0.9	0.9	0.9	4.3	2.5	1.7	1.3	7.2	5.9	3.8	1.2
4		1.8	1.5	2.7	1.5	4.3	2.5	1.7	1.1	8.3	7.8	4.9	1.2
5		0.9	0.4	0.2	0.6	2.8	1.3	1.0	0.6	4.8	4.3	2.6	0.4
7		4.4	0.6	0.7	0.5	5.1	1.7	1.5	1.3	8.5	9.4	12.3	1.0
9		0.8	0.6	0.9	1.2	4.4	2.3	1.9	1.4	4.8	6.3	3.3	2.0
12		1.0	0.9	0.6	1.7	2.4	2.1	1.0	1.0	6.9	5.5	1.5	1.5
14		0.9	0.8	0.6	0.5	3.0	2.2	1.4	0.7	7.0	5.0	2.6	0.5

Table 6. Percentage Means and Standard Deviations of Intramuscular Triglyceride Fatty Acid Composition.

Means:		<u>14:0</u>	<u>14:1</u>	<u>15:0</u>	<u>isol6</u>	<u>16:0</u>	<u>16:1</u>	<u>17:0</u>	<u>isol8</u>	<u>18:0</u>	<u>18:1</u>	<u>18:2</u>	<u>20:0</u>
Acid ---	Station												
	1	2.6	0.8	0.4	0.2	30.2	3.8	1.4	0.6	17.7	39.8	1.2	0.4
	2	3.1	0.9	0.3	0.3	27.8	4.5	1.2	0.6	18.3	40.1	1.8	0.3
	3	3.5	1.0	0.5	0.2	28.2	4.8	1.7	0.5	17.5	39.1	2.4	0.1
	4	2.8	0.6	0.4	0.3	33.3	3.6	1.2	0.8	18.8	35.5	1.8	0.6
	6	3.3	1.0	0.5	0.1	27.6	5.5	1.3	1.1	11.5	45.9	1.6	0.3
	7	2.9	0.7	0.4	0.2	27.5	4.8	1.5	0.9	17.8	39.0	3.0	0.6
	9	3.6	1.0	0.5	0.2	29.6	4.7	1.2	0.9	16.7	39.0	2.0	0.3
	12	2.7	0.9	0.5	0.4	26.4	4.8	1.4	0.9	16.4	42.0	2.8	0.5
	14	3.1	1.0	0.4	0.2	26.1	5.6	1.4	0.9	15.9	43.3	1.7	0.2
Total x:		3.1	0.9	0.4	0.2	28.5	4.7	1.4	0.8	16.7	36.1	2.0	0.4
Std.Dev.:													
Station	1	1.0	0.3	0.2	0.2	5.1	1.1	1.6	0.3	4.4	5.9	1.9	0.8
	2	0.6	0.5	0.1	0.4	3.8	0.7	0.4	0.2	1.9	4.3	1.5	0.5
	3	1.0	0.4	0.3	0.3	2.9	1.2	1.0	0.6	4.4	4.3	1.2	0.2
	4	0.9	0.3	0.3	0.2	5.1	1.1	0.7	0.4	3.2	7.9	1.1	0.7
	6	0.6	0.4	0.1	0.1	1.7	0.8	0.4	0.3	1.2	2.0	0.9	0.2
	7	1.4	0.5	0.3	0.5	3.5	1.3	0.7	0.8	3.8	4.4	3.6	1.7
	9	0.9	0.5	0.2	0.3	4.2	1.4	0.5	1.2	3.7	4.3	0.9	0.4
	12	0.4	0.3	0.3	0.4	2.6	0.9	0.4	0.5	1.7	1.3	1.0	0.6
	14	0.7	0.4	0.3	0.2	3.2	1.2	1.0	0.7	1.9	3.8	1.4	0.3

Table 7. Percentage Means and Standard Deviations of Subcutaneous Triglyceride Fatty Acid Composition.

Means:		14:0	14:1	15:0	isol6	16:0	16:1	17:0	isol8	18:0	18:1	18:2	20:0
Acid	Station												
1	1	4.5	2.0	0.7	0.2	25.5	5.2	1.5	1.0	15.6	39.9	1.2	0.4
2	2	4.0	1.4	0.5	0.2	27.7	5.8	1.3	1.1	14.4	41.3	1.8	0.4
3	3	4.0	1.4	0.5	0.1	26.9	5.6	1.1	0.8	15.6	41.4	2.2	0.2
4	4	3.9	1.5	0.5	0.3	31.9	4.1	1.2	1.1	14.0	37.2	2.1	0.4
6	6	4.0	1.9	0.4	0.2	28.4	7.2	1.2	1.3	9.7	42.1	1.9	0.8
7	7	3.9	1.7	0.5	0.2	24.8	7.3	1.2	1.1	14.9	41.2	2.4	0.4
9	9	5.0	1.9	0.6	0.2	30.0	5.4	1.1	0.8	12.7	38.6	2.1	0.4
12	12	3.8	1.6	0.5	0.3	28.2	5.4	1.2	1.0	14.1	39.7	2.4	0.9
14	14	4.0	1.5	0.5	0.2	28.1	5.5	1.2	1.0	13.3	41.9	1.5	0.2
Total x:		4.1	1.7	0.5	0.2	28.0	5.4	1.2	1.0	13.8	40.4	2.0	0.4
Std. Dev.:													
Station													
1	1	1.0	0.7	0.2	0.2	2.1	1.1	0.5	0.5	2.8	2.8	1.2	0.6
2	2	0.7	0.3	0.2	0.1	2.0	0.7	0.4	0.4	1.6	2.3	0.6	0.2
3	3	0.8	0.5	0.2	0.1	2.4	1.4	0.5	0.3	3.8	3.7	0.8	0.2
4	4	1.0	0.4	0.2	0.1	3.5	1.2	0.3	0.9	3.0	5.9	1.1	0.4
6	6	0.6	0.6	0.1	0.1	1.3	1.0	0.2	0.3	1.9	1.6	0.7	0.4
7	7	0.7	0.5	0.2	0.1	2.0	0.9	0.2	0.2	2.8	2.0	0.6	0.4
9	9	0.6	0.4	0.1	0.1	2.7	1.0	0.3	0.3	2.5	2.4	0.8	0.4
12	12	0.5	0.3	0.2	0.2	2.3	0.7	0.3	0.4	1.6	2.9	1.8	0.6
14	14	0.8	0.4	0.1	0.1	1.8	1.0	0.4	0.3	1.9	3.0	0.7	0.3

Table 8. Percentage Means and Standard Deviations of Blood Serum Cholesterol-Ester Fatty Acid Composition.

Means: Acid --- Station	14:0	14:1	15:0	isol6	16:0	16:1	17:0	isol8	18:0	18:1	18:2	20:0
1	3.9	5.8	2.5	2.0	18.3	9.0	1.3	0.9	5.8	15.6	25.2	3.0
2	2.1	3.3	1.4	1.4	21.2	5.0	1.7	0.9	10.5	19.8	20.5	1.5
3	2.8	2.7	1.8	0.9	14.5	6.8	2.0	0.8	4.6	10.7	44.6	2.2
4	3.0	3.1	3.2	2.2	21.9	9.2	4.1	2.1	12.5	17.2	10.9	4.0
5	4.7	1.6	1.4	0.6	19.0	4.8	1.5	0.9	5.4	12.9	36.9	1.5
7	2.6	1.1	0.9	0.6	18.3	4.5	1.0	0.5	11.2	20.1	31.7	2.1
9	2.8	1.4	1.4	0.9	17.1	5.5	2.0	0.8	7.4	13.3	41.1	1.8
12	3.0	2.6	1.1	2.0	16.5	5.4	0.6	1.2	8.1	11.7	36.9	3.1
14	3.8	4.4	3.0	1.5	19.2	10.7	3.3	1.2	5.5	14.8	25.8	0.8
Total x:	3.2	2.9	1.9	1.4	18.4	6.8	1.9	1.0	7.9	15.1	30.3	2.2
Std.Dev.: Station												
1	1.7	4.4	1.9	2.1	6.2	3.9	1.2	1.3	4.3	5.0	18.0	4.6
2	1.5	2.0	1.9	0.8	7.2	1.8	1.8	0.7	4.9	11.7	20.1	4.2
3	1.5	1.6	1.0	1.0	6.5	2.4	1.9	1.1	2.9	5.6	18.4	2.3
4	1.5	2.0	2.1	2.3	8.1	3.7	4.4	2.3	6.2	7.8	10.9	4.4
6	2.0	1.6	1.4	0.4	5.3	3.4	1.4	0.7	2.6	4.9	16.2	0.5
7	2.4	1.2	1.0	0.6	7.5	2.0	1.3	1.0	8.0	13.0	20.9	2.3
9	1.4	1.0	0.8	1.0	6.8	2.0	1.4	0.8	4.7	5.5	17.4	1.8
12	1.7	1.8	0.9	1.6	5.8	2.5	1.0	1.5	4.8	6.2	22.0	2.3
14	2.0	1.6	2.0	0.9	5.6	3.0	1.7	1.4	3.2	4.6	15.5	1.3

Table 9. Percentage Means and Standard Deviations of Intramuscular Cholesterol-Ester Fatty Acid Composition.

Means: Acid --- Station	14:0	14:1	15:0	isol6	16:0	16:1	17:0	isol8	18:0	18:1	18:2	20:0
1	3.8	2.1	2.3	2.8	25.3	4.0	2.0	0.7	15.9	25.2	1.5	0.7
2	4.6	1.0	1.6	1.2	23.6	2.2	1.3	0.8	16.1	28.4	1.7	0.6
3	4.7	1.5	0.6	0.4	22.8	4.3	1.8	0.8	17.8	29.2	4.2	0.4
4	3.7	0.8	1.2	1.2	24.6	3.4	0.9	1.7	20.7	34.0	2.4	0.5
6	2.7	0.6	1.7	0.1	38.8	2.2	0.6	0.2	16.9	32.9	1.5	0.2
7	4.5	0.7	0.4	0.9	23.9	4.7	0.9	0.4	18.8	32.8	3.4	0.4
9	5.0	1.8	2.0	1.2	22.5	3.8	3.1	0.7	18.9	26.5	2.9	0.8
12	5.3	0.8	1.0	0.7	27.1	3.3	1.5	0.4	19.1	29.0	2.4	0.2
14	5.1	1.0	1.1	0.4	24.9	3.9	1.6	0.4	17.5	29.9	3.3	0.4
Total x:	4.4	1.1	1.3	1.0	25.9	3.5	1.4	0.7	18.0	29.8	2.6	0.5
Std.Dev.: Station												
1	2.6	2.1	2.8	3.6	5.1	3.2	2.4	1.0	3.0	9.7	1.7	1.2
2	4.0	1.3	1.2	1.2	7.3	1.8	1.0	1.2	5.6	9.5	2.7	1.2
3	2.0	1.1	0.5	0.8	8.3	2.0	1.6	1.2	5.0	7.4	6.2	1.3
4	1.8	1.3	1.9	1.4	4.9	1.9	1.3	2.6	4.0	9.4	5.2	1.1
6	0.8	0.6	1.3	0.1	5.6	0.7	0.2	0.2	2.3	3.4	0.5	0.4
7	4.1	1.1	0.6	2.0	5.9	3.0	1.1	0.7	6.5	8.8	5.1	0.9
9	2.8	2.4	2.7	1.3	6.8	2.4	2.5	1.3	4.8	7.7	2.9	2.6
12	4.4	0.8	1.6	0.7	5.2	1.8	2.0	0.5	3.2	8.3	2.2	0.4
14	3.4	1.0	3.1	0.6	8.0	2.2	1.6	0.8	4.6	7.4	5.3	1.3

Table 10. Phenotypic Correlations of Lipid Class Concentrations Between Tissues, Total Serum Lipid, Total Intramuscular Fat and Dry Matter of 297 Herefords.

	Blood Serum							
	<u>P-L</u>	<u>Chol</u>	<u>FFA</u>	<u>T-G</u>	<u>C-E</u>	<u>S,Lip</u>	<u>IM,Fat</u>	<u>D-M</u>
<u>IM:</u>								
P-L	.03	.02	-.02	-.01	.04	.03	.27	-.01
M-G	.03	-.07	-.00	-.06	.05	.01	.36	.01
D-G	.08	-.01	.03	-.02	.11	.08	.44	.03
Chol	.13	.03	-.00	-.02	.09	.09	.57	-.03
FFA	.14	.05	.07	-.00	.15	.15	.48	.03
T-G	.18	.16	.19	.03	.13	.21	.96	.24
C-E	.05	.01	-.06	.16	.10	.08	.32	.03
<u>S-Q:</u>								
P-L	-.03	.04	-.01	-.04	-.01	-.02	.01	.10
M-G	-.08	-.02	-.06	.03	-.04	-.06	-.02	.04
D-G	-.10	-.06	-.11	-.08	-.00	-.08	-.02	.08
Chol	-.03	.03	-.00	-.02	.04	.02	.04	.05
FFA	.01	-.06	-.09	-.01	.05	-.01	.07	.16
T-G	.06	.03	.08	.03	-.02	.04	-.02	-.11
C-E	-.14	-.04	-.04	.07	-.06	-.09	-.04	-.07
S,Lip	.78	.82	.50	.27	.79	1.00	.21	-.04
IM,Fat	.19	.15	.17	.01	.16	.21	1.00	.20
D-M	.02	-.02	.02	.08	-.06	-.04	.20	1.00

Levels of Significance: 5% = 0.11, 1% = 0.15.

- S = Serum
 IM = Intramuscular Fats
 S-Q = Subcutaneous Fats
 P-L = Phospholipids
 M-G = Monoglycerides
 D-G = Diglycerides
- Chol = Cholesterols
 FFA = Free Fatty Acids
 T-G = Triglycerides
 C-E = Cholesterol Esters
 Lip = Lipid
 D-M = Dry Matter

Table 11. Phenotypic Correlations of Lipid Class Concentrations
Between Intramuscular and Subcutaneous Tissues of 297
Herefords.

	<u>Intramuscular</u>						
	<u>P-L</u>	<u>M-G</u>	<u>D-G</u>	<u>Chol</u>	<u>FFA</u>	<u>T-G</u>	<u>C-E</u>
<u>S-Q:</u>							
P-L	.00	.00	-.04	.02	-.03	.01	.05
M-G	.04	.02	-.04	-.06	-.02	-.02	.10
D-G	.06	.00	-.02	-.02	.00	-.04	.07
Chol	.03	.02	.06	-.03	.02	.03	.05
FFA	.06	-.05	.01	.05	.00	.07	.10
T-G	-.06	.01	.01	.00	.02	-.02	-.09
C-E	.00	.01	-.03	.06	-.02	-.04	-.10

Table 12. Least Squares Analysis of Variance of Lipid Class Concentrations, Total Serum Lipid, Intramuscular Fat and Dry Matter by Sex, Station, and Sires per Station per Year of 297 Herefords.

	Sex, Station, Sires/Station/Year												
Lipid Class:	1	2	3	4	5	6	7	8	9	10	11	12	13
Serum:													
P-L		11.0*		4.0*			3.0*						
Chol		6.5*					4.1*					2.1	
FFA		7.8*		3.8*							2.2		
T-G	3.1	3.7*					4.0*						
C-E		22.1*										2.0	2.4
I-M:													
P-L		5.5*								3.9*		2.3	
M-G		19.4*									2.9*		
D-G		20.6*	4.9*			4.6*					2.3		
Chol		31.3*	3.7										
FFA		13.7*			11.2*	5.7*							
T-G	23.7*	23.2*	3.8			3.0*				5.2*	2.8*		
C-E		15.8*				2.6							
S-Q:													
P-L		46.4*		5.4*				2.9					2.9
M-G		29.2*		3.2									5.1*
D-G		9.8*										3.2*	
Chol		9.9*											4.4*
FFA		20.4*						2.9				3.9*	
T-G		18.4*										2.5*	3.2
C-E		3.0*									5.0*		12.8*
S,Lip		9.2*					2.7						
IM,Fat	16.8*	28.2*	5.7*			3.7*				4.4*	3.1*		
D-M	7.2*	23.6*								4.0*			
d.f.	2	11	3	3	1	8	6	5	5	3	6	9	4

Only significant, 5% and 1%, F values are listed; 1% = *.
Col.: 1 = Sex; 2 = Station/Year; 3 = Hawaii sires, yr.1; 4 = Hawaii sires, yr. 2; 5 = California sires; 6 = San Juan sires, yr.1; 7 = San Juan sires, yr. 2; 8 = Oregon sires; 9 = Miles City sires; 10 = New Mexico sires, yr. 1; 11 = New Mexico sires, yr. 2; 12 = Havre sires, yr.1; 13 = Havre sires, yr. 2.

Table 13. Analysis of Variance of the Fatty Acid Concentration in Serum Lipid Classes by Sex, Station, Year and Sires per Station of 297 Herefords.

<u>Sex, Station, Year, Sires/Station</u>												
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u> <u>13</u>
<u>S,P-L:</u>												
C14:0		2.4*		4.2*			3.8*	8.1*				
C16:0		22.7*		2.8								
C16:1		18.8*		3.6								
C17:0		15.2*		12.3*								
C18:0		23.9*										
C18:1		18.9*		4.1*								2.6
C18:2	7.1*	5.3*										4.4*
<u>S,FFA:</u>												
C14:0		4.0*										
C16:0		10.5*		3.4								
C16:1		4.1*										
C17:0		5.3*		4.0*								
C18:0		10.9*										
C18:1	3.4	10.8*	3.4									
C18:2		4.9*									2.2	
<u>S,T-G:</u>												
C14:0	5.1*	4.8*					2.3					
C16:0		7.9*										
C16:1							2.7					
C17:0		2.7*										
C18:0		4.6*	3.4									2.5
C18:1		5.1*				3.7*	2.8					
C18:2		2.5*							2.7			
<u>S,C-E:</u>												
C11:0		2.8*										
C14:0	7.4*	5.4*			9.0*							
C15:0	6.2*	2.6*			10.4*							
C16:0	4.6	7.8*				2.1						
C16:1		13.8*	3.1	2.8				2.9				
C17:0		6.2*			6.7	2.3		7.7*			2.3	
C18:0		7.4*										
C18:1		3.3*										
C18:2		10.8*				2.1						
d.f.	2	11	3	3	1	8	6	5	5	3	6	9 4

Only significant, 5% and 1%, F values are listed; 1% = *.

Table 14. Analysis of Variance of the Fatty Acid Concentration in Intramuscular Lipid Classes by Sex, Station, Year and Sires per Station of 297 Herefords.

Sex, Station, Year, Sires/Station													
	1	2	3	4	5	6	7	8	9	10	11	12	13
IM,P-L:													
C14:0		2.8*										2.3	7.2*
C16:0		8.2*								8.0		2.9*	3.0
C16:1		4.1*											
C17:0		3.7*											7.0*
C18:0		5.7*								4.4*		2.1	
C18:1		12.0*								2.8		4.0*	3.4*
C18:2	3.9	13.3*				3.5*						3.8*	
IM,FFA:													
C14:0	4.5	9.2*			4.8	2.0							
C16:0	10.0*	15.4*			14.2*	4.3*							
C16:1	4.2	5.2*											
C17:0								3.5*					
C18:0	12.8*	9.7*				3.3*							
C18:1	7.7*	15.1*			35.2*	4.2*							
C18:2	15.6*	4.7*						5.0*					2.6
IM,T-G:													
C14:0	5.5*	5.1*										2.1	
C16:0	4.9	4.9*		5.5*						3.2*			
C16:1	15.0*	7.6*										3.1*	
C17:0	5.1*	2.3*		5.4*									
C18:0		5.6*					2.2			2.7			2.8
C18:1	15.5*	11.6*											
C18:2				3.8*								2.0	
IM,C-E:													
C11:0	6.8*	5.7*				2.1	2.2		2.8				
C14:0	4.2	15.7*				7.4*							
C15:0	4.0	7.9*		7.5*		2.5							
C16:0		3.9*						3.8*					
C16:1	5.8*	10.6*											
C17:0	5.3*	13.2*											
C18:0		2.7*								7.8*			
C18:1	7.2*	13.6*											
C18:2	7.2*	13.6*											
d.f.	2	11	3	3	1	8	6	5	5	3	6	9	4

Only significant, 5% and 1%, F values are listed; 1% = *.

Table 15. Analysis of Variance of the Fatty Acid Composition of Subcutaneous Triglycerides by Sex, Station, Year and Sires per Station of 297 Herefords.

	<u>Sex, Station, Year, Sires/Station</u>												
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>
<u>SQ,T-G:</u>													
C14:0	9.3*	6.9*							2.4			2.9*	
C16:0		14.0*						3.5*					4.2*
C16:1	6.0*	9.0*	4.2*										
C17:0	4.0	5.3*			2.5								
C18:0	12.5*	7.3*							4.6				
C18:1		17.3*					2.6	5.4*				2.4	
C18:2		9.6*						2.3					
d.f.	2	11	3	3	1	8	6	5	5	3	6	9	4

Only significant, 5% and 1%, F values are listed; 1% = *.

Table 16. Heritability Estimates and Standard Errors of the Lipid Class Concentrations in Serum, Intramuscular and Subcutaneous Tissues of 297 Herefords.

<u>Estimates between:</u>	<u>Heritability</u>	<u>*Standard Errors</u>
S,P-L	.201	.201
S,Chol	.328	.212
S,FFA	.270	.207
S,T-G	-.004	.182
S,C-E	.287	.208
IM,P-L	-.131	.168
IM,M-G	.049	.187
IM,D-G	.335	.212
IM,Chol	-.063	.175
IM,FFA	.375	.215
IM,T-G	.707	.236
IM,C-E	-.249	.154
SQ,P-L	.060	.188
SQ,M-G	.336	.212
SQ,D-G	.492	.224
SQ,Chol	.153	.197
SQ,FFA	.621	.232
SQ,T-G	.484	.223
SQ,C-E	.630	.232
IM,Fat	.738	.238
S, Lip	.144	.196

Table 17. Genetic Correlations and Standard Errors of Lipid Class Concentrations in Serum, Intramuscular and Subcutaneous Tissues of 297 Herefords.

Correlations between:	Genetic Corr:	±Standard Errors
S,P-L & S,Chol	-.595	.395
" & IM,D-G	.792	.636
S,Chol & SQ,T-G	-.524	.431
S,FFA & IM,T-G	.717	.372
" & IM,Fat	.529	.375
" & S,Lip	.816	.439
S,C-E & IM,D-G	.936	.521
" & IM,T-G	.456	.378
" & SQ,D-G	.663	.473
" & IM,Fat	.537	.366
" & S,Lip	.641	.384
IM,D-G & IM,FFA	1.054	.212
" & IM,T-G	.977	.296
" & SQ,FFA	.681	.399
" & IM,Fat	1.065	.237
" & S, Lip	.970	.831
IM,FFA & IM,T-G	.957	.259
" & SQ,D-G	.625	.411
" & SQ,FFA	.637	.378
" & SQ,T-G	-.541	.409
" & IM,Fat	1.080	.202
IM,T-G & IM,Fat	.986	.014
" & S, Lip	.535	.524
SQ,FFA & SQ,T-G	-.990	.583
" & IM,Fat	.400	.281
SQ,T-G & IM,Fat	-.363	.322
IM,Fat & D-M	0.	.157
" & S, Lip	.526	.516
D-M & S, Lip	0.	.157

Table 18. Means and Standard Deviations of Lipid Classes, Total Serum Lipid, Total Intramuscular Fat and Dry Matter of 297 Herefords

<u>Variable</u>	<u>Means</u>	<u>Standard Deviations</u>
S,P-L	25.7	7.3
S,Chol	17.5	3.4
S,FFA	10.4	4.2
S,T-G	4.7	3.1
S,C-E	41.5	9.3
IM,P-L	8.0	4.8
I,M-G	1.9	1.4
I,D-G	2.3	2.1
I,Chol	7.8	3.4
I,FFA	4.8	2.8
I,T-G	74.1	8.6
I,C-E	1.2	1.1
SQ,P-L	1.5	2.0
SQ,M-G	1.1	0.9
SQ,D-G	2.4	1.3
SQ,Chol	2.5	1.7
SQ,FFA	4.8	2.1
SQ,T-G	87.6	5.7
SQ,C-E	0.1	0.3
D.M.	26.2	3.9
IM,Fat	14.5	6.9
S,Lip	35.5	9.1

UNIVERSITY OF HAWAII

- I. Station: Hawaii Agricultural Experiment Station
- II. Project title: The estimation of genetic and phenotypic parameters in populations of beef cattle in Hawaii and their use in selection programs.
- III. Personnel:
 - Experiment Station:
 - Estel H. Cobb, Project Leader, Isaac I. Iwanaga, Kiyoichi Morita, Diedrich Reimer, and C. M. Campbell
 - Hawaiian Ranch Company
 - Tom Liggett
 - Kahua Ranch Company, Ltd.
 - Monty Richards, Jr.
 - U. S. Department of Agriculture, Agricultural Research Service, Fort Collins, Colorado
 - Bradford W. Knapp, Acting Investigations Leader
- IV. and V. Nature and extent of work done this year and summary of progress:

Breeding groups for the crossbreeding study were made up according to the schedule of rotating cows annually between the Angus, Hereford and Charolais breeding groups. Heifers produced in this project were exposed to bulls simultaneously with the cows. Angus and Hereford heifers were bred to produce straightbred calves; crossbred heifers were exposed to bulls of a third breed. Weights were obtained on all calves within 24 hours after birth.

Weaning weights and grades were obtained on the 1968 calf crop as scheduled. All steer calves (43) were sent to the Waialeale Research Farm on Oahu for postweaning evaluation, including slaughter and carcass information.

Sire additions to the project include the purchase of 2 Hereford bulls and the loan of 2 Angus bulls from Hawaii breeders, plus 4 Charolais bulls imported from the 4-T ranches, Georgetown, Texas.

Data from 131 Hereford steers representing 24 sires for the period 1959-64 were analyzed by the method of least squares to determine the effects of years, sires, carcass weight, and ration on carcass quality and eating quality. Sixty-three of the steers were fattened under feedlot conditions and the remaining 68 steers were finished on grass with little or no additional feed. The traits studied were carcass grade, marbling, specific gravity, percent

moisture, protein, and ether extract in ribeye muscle, tenderness, juiciness, flavor, general acceptability, chew count, shear force, drip loss, evaporation loss, and total cooking loss. Rations had a large significant effect on all traits except percent protein, juiciness and evaporation loss during cooking. Meat from feedlot steers was more tender and flavorful. Juiciness was not affected by ration. Year differences were significant for all traits except percent protein and total cooking loss. Differences among sires were statistically highly significant for specific gravity and significant for carcass grade, percent ether extract and percent drip loss during cooking. Differences among sires for all other traits were nonsignificant.

Estimates of heritabilities and estimates of genetic, phenotypic and environmental correlations were computed from record of 357 bulls and 599 heifers. The traits studied were 12-month weight, average daily gain from birth to 12 months, 12-month conformation score, 20-month weight, average daily gain from birth to 20 months of age, 20-month conformation score and average daily gain from weaning to 20 months of age. Constants for the effect of sire, age of dam and year were fitted for each sex separately.

Differences between sires were highly significant for 12-month weight, average daily gain from birth to 12 months, average daily gains from birth to 20 months, and average daily gains from weaning to 20 months for bulls and 12-month weight, average daily gain from birth to 12 months and average daily gains from birth to 20 months for heifers. Differences between sires were statistically significant for 20-month score for bulls and heifers and average daily gain from weaning to 20 months for heifers. Differences between sires for other traits were not statistically significant for either heifers or bulls. Differences between years were highly significant for all traits of both sexes.

Age of dam had no significant effect on any of the traits of bulls but had significant effects on all traits of heifers except average daily gain from weaning to 20 months of age.

Age of calf had a significant effect on 12-month weight and 12-month score of bulls and 12-month weight, 12-month score, 20-month weight, 20-month score of heifers. Significant curvilinear regressions on age of calf were found for 12-month and 20-month conformation scores of heifers.

The estimates of heritability for bulls and heifers were 0.75 and 0.26 for 12-month weight, 0.77 and 0.29 for rate of gain from birth to 12 months, 0.09 and 0.04 for 12-month score, 0.79 and 0.43 for 20-month weight, 0.78 and 0.44 for rate of gain from birth to 20 months, 0.27 and 0.09 for 20-month score and 0.54 and 0.10 for rate of gain from weaning to 20 months.

The genetic correlations among the traits of bulls and heifers were high except the correlations of weight and rate of gain at 12 months with 12-month conformation scores of bulls and with 20-month conformation score of heifers. The environmental and phenotypic correlations were generally high except the correlations of rate of gain from weaning to 20 months with 12-month traits.

VI. Application of findings:

Results to date indicate that significant heterosis exists for preweaning and postweaning traits among crosses of the Angus, Hereford and Charolais breeds of beef cattle. These traits include birth weight, preweaning growth rate, weaning weight, postweaning daily gains and 20-month weights. Cows bred to produce crossbred calves were superior in reproductive performance to those bred to produce straightbred calves. Conformation score at weaning has not shown significant response to method of breeding.

VII. Work planned for the future:

The crossbreeding study will continue as planned. Weaning and postweaning records will be taken on the cooperating ranches as outlined.

VIII. Publications and manuscripts:

Sarobol, Siriwat. Genetic and environmental effects of postweaning traits of range beef cattle. M.S. Thesis, University of Hawaii. June 1959.

Wilk, Christine A. The relation of some carcass traits to the eating quality and cooking characteristics of beef. M.S. Thesis, University of Hawaii. January 1959.

IX. Project summary:

Hawaii Agricultural Experiment Station

Cattle Inventory - June 1959					Total
Breed	Hereford	Angus	Charolais	Crossbred	
Bulls (12 mo. or over)					
Purebred	3	3 ^a	5	6	17
Cows (2 yrs. or over)					
Grade	65	73	--	60	198
Heifers (yearlings)	6	4	--	36	46
Steers (yearlings) ^b	8	7	--	29	44
Calves - Bulls	11	11	--	38	60
- Heifers	7	7	--	35	49

^aIncludes 2 Angus bulls on loan.

^bSteers calves sent to Waialeale Farm for feedlot and pasture trials.

Hawaii Agricultural Experiment Station

Cow Production Data - 1968 calf crop							Total
Breeding group	HxH	AxA	HxA	AxH	CxH	CxA	
Number cows bred to calve:							
At 3 yrs. and up	17	20	19	19	19	19	113
Number calves born - Alive	16	17	18	16	18	18	103
- Dead	1	2	0	0	0	1	4
Number calves weaned	15	17	18	15	18	18	101
Percent calf crop ^a - Born	94.1	85.0	94.7	84.2	94.7	94.7	91.2
- Weaned	88.2	85.0	94.7	79.0	94.7	94.7	89.4

^aBased on number of cows exposed and number of calves born alive.

Prewaning Performance Data - 1968 calf crop						
Breeding group	HxH	AxA	HxA	AxH	CxH	CxA
Birth weights - Bulls	78	64	79	79	94	87
- Heifers	81	66	77	77	87	81
Weaning age - Bulls	238	254	242	244	238	248
- Heifers	234	251	253	243	236	243
Weaning weight - Bulls	425	460	496	503	518	522
- Heifers	446	461	495	459	453	492
Adjusted weaning weight ^a - Bulls	428	439	491	498	521	511
- Heifers	457	444	473	453	462	486
Conformation score ^b - Bulls	11.0	10.5	11.6	11.8	11.7	11.5
- Heifers	12.0	11.7	11.8	11.1	11.0	11.5

^aAdjusted 240-day weaning weight = weaning weight + ADG (240 - weaning age).

^bBased on feeder grades where 17-15 = Prime; 14-13 = Choice; 11-9 = Good; etc.

Hawaii Agricultural Experiment Station

Postweaning Performance and Carcass Traits of Steer Progeny by Year and Treatment (Cobb and Reimer, unpublished)

1966 Feedlot steers

Item	AxA ^a	AxH	HxH	HxA	CxA	CxH
No. of individuals	3	4	4	2	1	2
Initial wt. (shrunk), lb.	668.0	663.0	640.8	648.0	637.0	641.0
Final wt. (shrunk), lb.	1035.7	1005.8	1023.2	1032.5	1016.0	1014.5
Gain on test, lb.	367.7	342.8	382.5	382.5	379.0	373.5
Days on test	200.7	150.5	171.5	192.5	217.0	178.5
Daily gain, lb./day	1.84	2.33	2.28	2.00	1.75	2.30
Age at slaughter, days	778.3	622.0	668.5	671.0	736.0	670.5
Chilled carcass wt., lb.	686.2	633.9	647.5	670.5	663.0	633.5
Carcass grade ^b	20.7	19.0	19.0	19.5	20.0	19.5
Marbling score ^c	7.0	4.7	4.7	5.5	6.0	5.5
Area of ribeye, sq. in.	12.1	12.1	10.8	10.2	10.6	10.2
Fat thickness, in.	1.08	0.72	0.71	0.76	0.40	0.48
Retail cuts, %	59.1	63.0	62.7	61.0	63.8	64.3

1967 Feedlot steers

Item	AxA ^a	AxH	HxH	CxA	CxH
No. of individuals	3	4	4	2	2
Initial wt. (shrunk), lb.	624.3	631.5	617.8	639.5	642.0
Final wt. (shrunk), lb.	1012.3	1011.3	1010.8	990.0	1024.0
Gain on test, lb.	388.0	379.8	393.0	350.5	382.0
Days on test	179.7	155.8	201.3	140.0	112.0
Daily gain, lb./day	2.17	2.50	1.97	2.52	3.42
Age at slaughter, days	651	620	704	530	551
Chilled carcass wt., lb.	623.5	641.9	660.1	606.8	627.0
Carcass grade ^b	20.0	19.8	19.8	19.0	19.0
Marbling score ^c	5.7	5.8	6.3	5.0	4.5
Area of ribeye, sq.in.	10.8	12.1	11.4	12.6	10.7
Fat thickness, in.	0.88	0.78	0.96	0.40	0.45
Retail cuts, %	60.0	62.2	62.8	66.9	65.0

^aA = Angus, H = Hereford, C = Charolais

^b21 = Choice, 20 = Average Choice, 19 = Low Choice, 18 = High Good, etc.

^c6 = modest, 5 = small amount, 4 = slight amount, down to 1 = devoid.

Hawaii Agricultural Experiment Station

Postweaning Performance and Carcass Traits of Steer Progeny by Year and Treatment (Cobb and Reimer, unpublished)

1967 Pasture steers

Item	AxH ^{a,d}	HxH ^d	HxA ^d	CxA	CxH
No. of individuals	3	4	3	2	3
Initial wt. (shrunk), lb.	618.7	624.3	624.0	631.5	624.0
Final wt. (shrunk), lb.	1015.7	1020.5	1030.3	1014.5	1006.7
Gain on test, lb.	397.0	396.2	406.3	383.0	383.7
Days on test	333.3	288.8	338.3	294.0	268.3
Daily gain, lb./day	1.19	1.38	1.21	1.30	1.44
Age at slaughter, days	767.0	722.0	781.0	700.5	666.0
Chilled carcass wt., lb.	627.7	609.6	625.5	604.0	586.5
Carcass grade ^b	19.0	18.2	19.3	17.5	18.0
Marbling score ^c	5.7	5.0	5.7	4.5	5.0
Area of ribeye, sq.in.	11.7	11.3	11.5	11.1	10.1
Fat thickness, in.	0.66	0.60	0.46	0.42	0.46
Retail cuts, %	63.2	64.2	64.6	65.4	65.1

^aA = Angus, H = Hereford, C = Charolais

^b21 = Choice, 20 = Average Choice, 19 = Low Choice, 18 = High Good, etc.

^c6 = modest, 5 = small amount, 4 = slight amount, down to 1 = devoid.

^dOne animal from each of these groups still on test. All traits involving age of animals will be lower when these are averaged in.

UNIVERSITY OF IDAHO

- I. Station: Idaho Agricultural Experiment Station
- II. Project title: The improvement of economically important traits in beef cattle with special emphasis on fertility and carcass quality
- III. Personnel:

Experiment Station:

R. E. Christian, Project Leader, T. D. Bell, Morris Hemstrom,
L. E. Orme, C. W. Hodgson, S. E. Slyter

U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado

Bradford W. Knapp, Acting Investigations Leader

- IV. and V. Work done this year and summary of progress:

A summary of seven years of progeny testing of university produced sires has been completed. Because of the wide yearly variation in most traits studied it is apparent that more than 10 offspring per sire are necessary to detect a true mean difference of ten per cent.

Correlations among the various live animal and carcass traits were not homogeneous over the seven years studied. Removal of data in steers slaughtered under 900 lb. live weight made 70 percent of the correlation data homogeneous.

Curvilinear relationships studied suggest that only two variables, estimated per cent retail yield and estimated weight of retail yield, were improved by including quadratic and higher powers in estimating the coefficient of determination compared to a simple linear estimation. Very few correlations were of sufficient magnitude to be of value as predications of carcass composition and quality.

The first group of calves from the six bulls (two Hereford, two Angus and two Shorthorn) leased to one commercial cattleman have been slaughtered. However, the data have not been summarized to determine the extent of breed and sire-within-breed differences.

The genetic study of fertility has been continued. From preliminary analysis it would appear that there is, in fact, a decline in fertility from first service to later services. This is what would be expected if fertility has a heritability greater than zero. Studies are now underway to determine the decline to be expected in fertility at later services if the heritability is assumed to have various values. This study will be continued.

VI. Application of findings:

The finding that progeny tests conducted over more than one year requires relatively large numbers of offspring to detect differences as large as ten per cent will be of significance to breeders who desire to progeny test their herd sires.

VII. Work planned for the future:

The progeny testing study will be continued this year.

The study of the genetic basis of fertility will be expanded to ascertain the fertility pattern to be expected if the true heritability of fertility is greater than zero.

VIII. Publications and manuscripts:

Atchley, C. A. 1969. Statistical analysis of a seven year carcass evaluation and progeny testing program. M. S. Thesis.
University of Idaho.

IX. Project Summary:

Idaho Agricultural Experiment Station

Cattle Inventory - June 1969				Total
Breed	Hereford	Shorthorn	Angus	
Purebred or grade		Purebred		
Bulls (12 mos. or over)	11	4	5	20
Cows (2 yrs. or over)	58	27	30	115
Heifers (yearlings)	10	5	5	21
Calves - Bulls	22	12	14	48
- Steers	24	13	12	49

Cow Production Data - 1968 calf crop				Total
Breed	Hereford	Shorthorn	Angus	
Purebred or grade		Purebred		
Number of cows bred to calve:				
As 2-yr.-olds	17	5	7	30
At 3 yrs. and up	38	23	25	86
Number calves born from:				
2-yr.-olds - Alive	13*	5	3	21
- Dead	2	0	0	2
3-yr.-olds and up - Alive	32	20	8	60
- Dead	1	0	0	1
Number of calves weaned	44	23	11	78
Percent calf crop - Born	81.8	85.2	34.4	69.8
- Weaned	80.0	79.3	34.4	67.2

*Includes one set of twins

Prewaning Performance - 1968 calf crop				Average
Birth weight - Bulls	72.7	69.5	65.8	70.8
- Heifers	68.0	67.5	60.8	62.4
Weaning age - Bulls	230.0	251.0	219.8	233.6
- Heifers	231.1	249.7	208.2	232.7
Adjusted weaning - Bulls	382.0	398.7	359.2	379.7
weight* - Heifers	370.1	369.9	419.7	387.2
Weaning score:				
Conformation - Bulls	12.5	12.5	13.4	12.5
- Heifers	12.0	11.9	12.2	12.0

*Adjusted to 205 days

MONTANA STATE UNIVERSITY

- I. Station: Montana Agricultural Experiment Station
- II. Project titles: 1. Recurrent selection and record of performance in open and closed beef cattle herds. 2. The genetics of certain protein components in milk from beef cows.
- III. Personnel:

Experiment Station:

R. L. Blackwell, Project Leader, F. S. Willson, A. E. Flower,
A. M. El-Negoumy, J. R. Dynes, and Claude Windecker

U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado

Bradford W. Knapp, Acting Investigations Leader

IV. Nature and extent of work done this year:

A study of carcass data of steer progeny from lines at the Havre Station indicated that line effects were generally small for dressing percent, carcass grade, marbling score, shear force value, and percent lean, fat and bone from the 9-10-11 rib section. There was evidence of line difference in area of 1. dorsi, however, when 1. dorsi area was expressed as area per unit carcass weight the line differences were removed. Line effects were found in some comparisons for fat thickness. Line 4 steers were generally superior to the crossline steers in estimated lean yield. The feeding-management appeared to affect the results of data analysis in certain instances.

Final feedlot weight of sire was positively correlated with slaughter weight, carcass weight, body length of progeny, but no important correlations were found between final weight of sire and carcass grade, dressing percent, ribeye area and fat thickness of the progeny carcass.

Heritability estimates were obtained from sire-progeny regressions as follows: birth weight, .50; weaning weight, adjusted, .01; final weight, .53; daily gain, .34; daily gain from birth to weaning, 0.0.

Laboratory analysis of the milk samples obtained from cows at the U. S. Range Livestock Experiment Station continues. More detailed techniques are being explored and evidence of additional protein warrants have been observed. This study should be concluded in the near future.

V. Work planned for the future:

Make the third set of linecross matings at the Havre Station in 1969. Maintain all female progeny for study of their maternal

abilities. Evaluate the feedlot performance and carcass merit of steer progeny. Instigate a breed crossing program at the main station using the Hereford, Angus, Holstein and Jersey breeds and specifically evaluate their potential for twinning by hormone therapy.

VI. Publications and manuscripts:

Dynes, J. R. 1968. Carcass trait differences in Hereford cattle lines, relationships between carcass traits and carcass and production traits from a 15-year recurrent selection program. Ph.D. Thesis, Texas A & M University.

Henderson, Richard A. 1968. A study of the relationship between growth traits and carcass characteristics in beef cattle. M. S. Thesis, Montana State University.

VII. Project Summary:

Montana Agricultural Experiment Station

Bozeman

Cattle Inventory - June 1969

Breed	Angus Purebred	Havre Hereford Linecross
Purebred or grade		
Bulls (12 mos. or over)	13	34
Cows (2 yrs. or over)	48	
Heifers (yearlings)	17	
Calves - Bulls	19	15
- Steers	7	4
- Heifers	26	13

Cow Production Data - 1968 calf crop

Breed Line (Sire)	Angus 294	Angus 355	Hereford Purebred	Hereford Linecross
Number cows bred to calve:				
As 2-yr.-olds	7	6	6	36
At 3 yrs. and up	17	25	10	0
Number calves born from:				
2-yr.-olds - Alive	6	5	3	28
- Dead	0	0	1	3
3-yr.-olds and up - Alive	16	24	7	--
- Dead	0	0	0	--
Number of calves weaned	22	28	10	28
Percent calf crop ^a - Born	91.6	93.5	68.7	86.1
- Weaned	91.6	90.3	62.5	77.8

Prewaning Performance - 1968 calf crop

Birth weight - Males ^b	72.1	68.8	68.7	71.15*
- Heifers	66.7	60.7	81.0	66.7
Weaning age - Males ^b	204.4	198.05	184.1	174.3*
- Heifers	204.2	181.0	177.7	172.1
Weaning weight - Males ^b	469.5	445.6	360.7	349.1*
- Heifers	431.7	369.6	396.7	328.0
Adjusted weaning weight ^c - Males ^b	488.4	473.1	401.8	418.4*
- Heifers	442.4	386.7	477.3	410.4
Weaning score:				
Conformation - Males ^c	81.4	80.4	75.8	77.5*
- Heifers	80.2	72.6	73.3	77.3

^aIndicate method of calculation - calves born ÷ cows exposed = % calf crop
calves weaned ÷ cows exposed = % calves weaned

^bIndicate bulls or steers *steers

^cIndicate method of adjustment - 205 day adj. for age of dam

Montana Agricultural Experiment Station - Havre

Cattle Inventory - June 1968												Total
Breed												
Hereford												
Line	HL 1	HL 2	HL 3	HL 4	HL 4 Grade	Bozeman	Crossline					
Purebred or grade	50	46	44	48	77	55						330
Bulls (12 mos. or over)	5	5	5	8		7						30
Cows (2 yrs. or over)	37	36	31	39	76	49						268
Heifers (yearlings)	13	10	13	9	1	16						62
Calves - Bulls	3	1	2	9		6						21
- Steers	15	17	14	6	10	14						76
- Heifers	4	5	2	16		2	92					121
Cow Production Data - 1968 calf crop												
Line	HL1	HL1	HL2	HL2	HL3	HL3	HL4	HL4	HL4	Boz	Boz	
Sire	270	373	353	426	342	403	359	432	430	533	534	
No. cows bred to calve:												
As 2-yr-olds	3	3	3	4	7	6	6	5	6	5	6	
At 3 yrs and up	24	23	23	22	19	21	21	22	15	21	22	
No. calves born from:												
2-yr.-olds - Alive	3	3	1	2	3	2	4	2	6	4	4	
- Dead	0	0	1	0	0	0	0	1	0	0	0	
3-yr.-olds and up - Alive	20	19	19	16	16	16	17	18	13	16	18	
- Dead	0	0	0	2	3	1	1	0	1	1	0	
No. calves weaned	23	22	20	18	19	18	21	19	19	20	22	
Percent calf crop ^a - Born	85.2	84.6	80.8	76.9	84.6	70.4	81.5	77.7	95.2	80.8	78.6	
- Weaned	85.2	84.6	76.9	69.2	73.1	66.7	77.8	70.4	90.5	76.9	78.6	
Preweaning Performance - 1968 calf crop												
Birth weight - Steers	87	85	88	89	79	83	79	84	79	76	78	
- Heifers	79	77	81	81	73	81	76	73	69	73	73	
Weaning age - Steers	170	177	175	179	185	180	173	175	179	160	174	
- Heifers	180	182	177	178	185	178	181	178	180	174	170	
Weaning weight - Steers	438	421	410	433	430	430	387	399	418	377	379	
- Heifers	422	413	397	397	386	439	387	365	357	373	370	
Adjusted weaning weight	456	424	420	432	422	429	399	395	418	415	389	
Weaning score:	419	407	402	399	377	441	384	369	356	384	387	
Conformation ^b - Steers	79	78	79	81	81	79	80	80	80	79	78	
- Heifers	80	80	79	79	79	80	78	78	78	79	80	

^aMethod of calculation - % of cows bred
^bIndicate method of adjustment - 180 days average of individual scores

Hayre

Postweaning Performance - 1967 calf crop

Breed	Hereford											
	HL 1	HL 1	HL 2	HL 2	HL 3	HL 3	HL 1	HL 2	HL 4	HL 4	HL 4	HL 4
Line	324	373	348	353	307	342	24	924	372	359		
Sire												
Sex												
Method of feeding												
Number on test	5	5	1	2	7	6	3	3	4	1		
Average age on test	189	193	170	196	197	194	181	180	188	197		
Initial weight	458	459	394	466	458	427	366	390	382	424		
Weaning score	81	79	79	82	82	80	79	79	81	79		
Days on test	256	240	278	251	247	255	271	271	257	250		
Average daily gain	2.34	2.53	2.42	2.63	2.40	2.39	2.40	2.36	2.65	2.56		
Feed efficiency:												
TDN/100 lbs. gain												
or												
Lbs. gain/100 lbs. grain	578	539	582	525	569	585	589	596	528	542		
Final weight	1054	1064	1068	1120	1050	1056	1006	1019	1059	1064		

Carcass

Fat thickness = 12th rib	17.8	12.4	9.3	21.9	11.8	18.6	18.4	20.2	14.7	16.7		
Rib-eye area - sq. in.	10.13	10.60	11.55	10.88	10.76	11.31	10.47	10.03	11.34	9.93		
Carcass weight	591	585	616	625	570	601	562	550	570	588		
Cutability - percent	48.4	50.3	50.0	50.0	50.5	49.8	48.4	50.0	50.0	47.7		
Carcass grade	18	19	19	19	18	19	18	19	19	18		

Montana Agricultural Experiment Station

Havre	Postweaning Performance - 1957 calf crop									
Breed	Hereford									
Line	HL 1	HL 2	HL 3	HL 4	HL 4	HL 4	HL 4	Boz.	Boz.	
Sire	24	924	967	359	372	430	324	423	423	
Sex	Bulls									
Method of feeding	Group									
Number on test	6	8	10	8	6	1	9	11	11	
Initial weight	469	435	431	420	433	384	405	400	400	
Weaning score	79	79	82	80	81	77	78	79	79	
Days on test	168	168	168	168	168	168	168	168	168	
Average daily gain	2.65	2.52	2.32	2.48	2.57	2.71	2.34	2.62	2.62	
Feed efficiency:										
TDN/100 lbs. gain										
or										
Lbs. gain/100 lbs. grain	437	469	478	465	423	454	508	447	447	
Final weight	914	859	821	839	853	839	798	839	839	

Montana Agricultural Experiment Station

Havre						
Postweaning Performance - 1967 calf crop						
Breed	Hereford					
Line	HL 1	HL 2	HL 3	HL 4	Boz.	Boz.
Sire	24	924	967	359	324	423
Sex		Bulls				
Method of feeding		Group				
Number on test	3	4	6	2	7	6
Initial weight	474	415	414	391	411	382
Weaning score	79	79	82	80	78	79
Days on test	243	245	274	262	273	255
Average daily gain	2.53	2.50	2.39	2.57	2.34	2.60
Final weight	1087	1023	1067	1055	1043	1040

Carcass						
Fat thickness = 12th rib	12.0	11.6	12.3	8.2	9.6	9.2
Rib-eye area - sq. in.	12.52	12.38	12.97	12.92	12.39	14.36
Carcass weight	579	543	582	561	573	579
Cutability - percent	50.7	52.3	51.9	51.6	51.0	52.3
Carcass grade	18	17	17	19	18	18

Montana Agricultural Experiment Station

Postweaning Performance - 1967 calf crop												
Breed	Angus ¹		Here- ford		Here- ford		Here- ford		Here- ford		Here- ford	
Line	Havre		Havre		Havre		Havre		Havre		Havre	
	Line 1		Line 2		Line 3		Line 4		Line 1		Line 2	
Sex	Bulls		Steers		Steers		Steers		Bulls		Bulls	
Method of feeding	Group		Group		Group		Group		Group		Group	
Number on test	16		13		13		5		6		8	
Average age on test ³ (days)	226		189		196		190		191		177	
Initial weight, lbs.	479		437		444		398		469		435	
Initial score -												
Conformation	82		80		81		80		79		79	
Days on test	140		258		255		255		168		168	
Average daily gain	2.95		2.35		2.37		2.60		2.65		2.52	
Final weight	892		1045		1060		1066		914		859	
Final score -												
Conformation	79		---		---		---		84		81	
									80		81	
											80	

Carcass			
Fat Thickness-12th rib mm	---	15.9	15.2
Rib-eye area - sq. in.	---	10.4	11.0
Carcass weight	---	582	584
Carcass grade ⁴	---	18.4	18.8

¹Angus data are for the 1968 calf crop at Bozeman.
²Calves born at Bozeman, raised and fed at Havre.
³Average weaning age.
⁴20 = choice, 17 = good

UNITED STATES RANGE LIVESTOCK EXPERIMENT STATION

I. Station: U. S. Range Livestock Experiment Station, Miles City, Montana.

II. Project titles:

- 03-30-025-313a-27 Breed crossing in beef cattle for increased production.
- 03-30-012-1-313a-27 Response to selection and genetic-environmental interaction in genetically similar Hereford cattle at two locations.
- 03-30-048-313a-27 Development and evaluation of closed lines of Hereford beef cattle.

III. Personnel:

U. S. Range Livestock Experiment Station, Miles City, Montana,
O. F. Pahnish, Project Leader, J. J. Urick, R. A. Bellows,
R. E. Short, T. M. Riley, R. B. Gibson, D. C. Anderson, and
W. L. Milmine

Montana Agricultural Experiment Station, Bozeman, Montana,
R. L. Blackwell, F. S. Willson, and N. A. Jacobsen

U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado
Bradford W. Knapp, Acting Investigations Leader

Cooperators:

U. S. Department of Agriculture, Agricultural Research Service,
Beltsville, Maryland

E. J. Warwick, Assistant Director, Animal Husbandry
Research Division

P. A. Putnam, Chief of Beef Cattle Research Branch

W. T. Butts, Jr., Investigations Leader (Southern Region),
Knoxville, Tennessee

W. C. Burns, Superintendent, West Central Florida Experiment
Station, Brooksville, Florida

Florida Agricultural Experiment Station, Gainesville
Marvin Koger, et al.

IV. and V. Nature and extent of work done this year with summary of progress and conclusions:

Project 03-30-025-313a-27 Breed crossing for increased production:

Phase 1

The results obtained through weaning from crossing beef x beef and beef x dairy breeds were published in the Journal of Animal Science. These results were covered in earlier annual reports.

Analyses of postweaning data are in progress. The analysis of postweaning data on heifers is complete, and a paper covering the results has been offered for presentation at the next annual meeting of the American Society of Animal Science.

The heifers were developed on pasture from weaning (October) to about 12 months of age (April). Hay and grain were offered during the winter months in amounts necessary to provide an average gain of about 0.8 lb. per day. Range forage was offered from about 12 months of age (April) to 18 months of age (October) except during the breeding seasons of 1965 and 1966. In these two years, heifers dropped in 1964 and 1965 were bred as yearlings and were in drylot on hay during the breeding seasons.

Estimates of heterosis in beef x beef crossbred heifers were as follows:

Trait	Means		Heterosis (%)
	Crossbred	Straightbred	
190-da. wt. (lb.)	448.9	444.3	1.0
361-da. wt. (lb.)	591.4	579.7	2.0
547-da. wt. (lb.)	794.7	784.1	1.4
ADG, 190-361 (lb.)	0.833	0.792	5.2
ADG, 190-547 (lb.)	0.968	0.953	1.6
ADG, 361-547 (lb.)	1.091	1.096	-.5
Score, 547 da. (points)	77.3	75.0	3.1**

**P<.01.

The Brown Swiss crossbred groups (HxB, HxC and AxC heifers) were each compared with beef straightbred and beef x beef crossbred groups within breed of sire. In these comparisons, the Swiss crossbreds were heavier at all ages than the groups with which they were compared. All weight differences were significant (P<.05 to P<.01) except for HxB versus HxC at 547 days. In 547-day score, the beef straightbred

and beef x beef crossbred groups consistently exceeded the Swiss crossbred groups ($P < .05$ to $P < .01$). Overall differences between the Swiss crossbreds and the beef straightbreds or beef x beef crossbreds were as follows:

Trait	Beef x Brown Swiss crossbreds minus:	
	Beef straightbreds	Beef x beef crossbreds
190-da. wt. (lb.)	73.6	69.0
361-da. wt. (lb.)	82.7	71.4
547-da. wt. (lb.)	91.3	81.4
ADG, 190-361 (lb.)	0.049	0.009
ADG, 190-547 (lb.)	0.049	0.033
ADG, 361-547 (lb.)	0.049	0.055
Score, 547 da. (points)	-4.7	-7.0

The weight advantages of beef x Brown Swiss heifers over beef straightbreds and beef x beef crossbreds at 361 and 547 days were attributable largely to differences in 190-day weaning weight. A relatively high level of milk production by the Brown Swiss dams seemed to be a major contributor to preweaning growth of the beef x Brown Swiss crossbreds. Although the Swiss crossbreds showed small advantages in postweaning gain over most other breed groups within breed of sire, the advantages were generally nonsignificant.

The analyses of postweaning data on the steers are yet incomplete. The steers were carried on a fattening ration to a final weight range of about 1000 to 1050 pounds. It appears that heterosis for initial weight and weights for each of the first four 28-day periods thereafter was about 4%. Heterosis in daily gains for the first four 28-day periods ranged from 2.3 to 4.5%. Heterosis percentages for ADG on test, slaughter grade and carcass grade were about 3.8, 2.6 and 1.1, respectively. The crossbred steers (first crosses of the Hereford, Angus and Charolais breeds) averaged about 244 days in the feedlot while the straightbreds of the beef breeds averaged 255 days.

Phase 2

This phase of the study was designed to evaluate maternal qualities of crossbred dams (two-breed crosses of the Hereford, Angus and Charolais breeds). All data for this phase have been collected and are being prepared for analysis.

The means suggest advantages for crossbred dams over straightbred dams of about 2% in calving percentage, 2% in weaning weight of calves adjusted for age and age of dam and about 0.6% in weaning score of calves.

The advantages shown by first-cross dams with Brown Swiss breeding (HxB, AxB and CxB combined) over straightbred dams of the three beef breeds appear to be about 10% for calving percentage (this estimate requires verification through further observations), 13% in weaning weight of calves adjusted for age and age of dam, and 2% in weaning score.

Rough estimates of gross returns were computed for straightbreeding with the beef breeds and breeding first-cross dams of the beef breeds to beef bulls for crossbred calves (three-breed crosses). Age of dam was assumed to be five years. Advantages shown in weaning traits of first-cross calves (Phase 1) were assumed to provide an estimate of the advantages for three-breed cross calves. Comparisons, by the Virginia Station, of two-breed and three-breed crosses with effects of crossbred dams eliminated were used as the basis for this assumption. Advantages of crossbred dams were estimated from data collected in Phase 2. Calf prices at weaning were set at \$26 to \$31 per cwt., depending upon sex, weight and grade. Sale weights were assumed to be weaning weights shrunk 3.0%. Effects of crossbreeding in the dam plus crossbreeding in the calf thus pointed to an annual advantage of about \$14 in gross return per cow exposed in the breeding herd.

Phase 3

This phase was designed to estimate hybrid vigor that can be obtained and maintained through two-way and three-way rotational crossing of the Hereford, Angus and Charolais breeds. In addition, a synthetic variety is being formed from the three beef breeds. For comparative purposes, another closed, two-sire group is being formed from the Brown Swiss crossbred females produced in Phase 1 and their subsequent progeny. The first crop of calves in this group will be those dropped in 1969. Phase 3 will be continued during the coming year according to the project plan.

Since the initiation of Phase 3, the crossbred dams have averaged somewhat above straightbred dams in calf crop percentage at weaning. The crossbred calves have averaged higher than straightbred calves in preweaning growth and postweaning feedlot gain. Calves from dams of 50% Brown Swiss breeding have shown preweaning growth advantages over the other groups. This is interpreted as an indication of a relatively high level of milk production by the crossbred dams with Swiss breeding. Additional data must be accumulated before the relative merits of straightbreds, rotational crossbred groups and synthetic groups can be determined with reasonable accuracy.

Project 03-30-012-1-313a-27 Genetic-environmental interaction study:

This study was continued according to the project plan. Comparisons that can be made thus far between the closed line from the Brooksville, Florida, foundation and the closed line from the

Miles City foundation are preliminary. Only the 1967 and 1968 calves from the control line (cows of Miles City foundation) are yet available to indicate effects of sire selection under the Brooksville environment.

The calves in the closed line of Miles City origin continued to be growthier than the calves in the closed line of Florida origin, as indicated by records on the 1968 calves through weaning. The difference in the preweaning and postweaning growth of heifer calves after the first two calf crops (1963 and 1964) decreased from a difference of 41-46 lb. to a difference of 21-26 lb. There is also a less consistent indication of a decreased difference in postweaning gain of heifer calves. Year to year differences in weaning weights of bull calves from the herds of Miles City and Florida origin show no pronounced trend. There is some evidence that the difference in feedlot gains of the two groups of bulls may be increasing.

Records through weaning on two crops of calves in the control herd (1967 and 1968) show no evidence of a detrimental effect from selection of sires for performance under the Brooksville, Florida, environment.

Project 03-30-048-313a-27 Development and evaluation of closed lines:

Development of Inbred Lines

An evaluation of progress in the selection of Line 1 cattle was made with data from two calf crops produced in the years 1966 and 1967. These calves were produced by artificial insemination from Line 1 bulls born in 1953 to 1955 and by bulls born in 1961 to 1963. Experimental procedures of this project have been described in previous reports. Only preliminary summaries of the data have been completed at this time and show that calves born from the 1961 to 1963 sires were heavier at birth, weaning, end of postweaning gain test in feedlot, and made somewhat larger gains on test than the sires born from 1953 to 1955. Calves from the 1961-63 sires scored slightly higher at weaning than those from the 1953-55 sires. Carcass grades of steers off feedlot test were similar for both groups of sires in 1967, but in 1968 the steers by the 1961 to 1963 sires averaged almost 1/3 grade higher, resulting mostly from a slightly higher degree of marbling.

The same procedure used for evaluating progress in Line 1 was initiated to evaluate Line 10 in 1967 and the first calves were dropped in 1968. Line 10 sires tested were those born from 1951 to 1955 and those born from 1963 to 1965. Except for added replacements, essentially the same cow herd was used for testing the Line 10 sires as was used to test the Line 1 sires. Preliminary data from the one calf crop from Line 10 sires show that calves from the 1963 to 1965 sires were heavier at birth and at weaning than those from the 1951 to 1955 sires (project summary). No apparent difference in weaning score was observed between calves from the two groups

of sires. An evaluation of postweaning performance of these calves will be completed at the end of feedlot test in July.

Selection for Carcass Traits

This study is continuing according to project outline.

Linecrossing Study - Phase 2

This study was designed to estimate maternal qualities of straightline and linecross dams resulting from Lines 1, 4, 6, 9 and 10. The fourth and final crop of calves were produced in this study in 1968 and are now in the final phase of their postweaning gain test. Over the four year period, calves each year from the linecross dams were heavier than those from straightline dams. Bull calves showed somewhat greater weaning weight and weaning score advantage as the result of being from linecross dams than did the heifer calves.

Bull calves each year from this study were fed out for 196 days following weaning in drylot. Postweaning performance showed practically no difference in the daily gain of bull calves from either the straightline or linecross dams. Thus these results suggest that the maternal effect of these two types of dams was not important past the weaning stage for influencing growth. The bulls by the linecross dams were heavier at end of feedlot test (approx. 13 mo. of age) than those by straightline dams, but this advantage was likely carried over from weaning.

Linecrossing Study - Phase 3

In this study four mating systems (within line mating, two-way rotation, three-way rotation and synthetic variety) are compared to obtain estimates of hybrid vigor that might be maintained over a period of time. Lines 1, 4, 6 and 10 are involved. Data through weaning are now available on calves born in 1967 and 1968. These preliminary data are too limited to be very meaningful yet. Comparisons of the bull calf weaning weights show the two and three-way crosses to be nearly equal and almost 40 pounds heavier than the straightline animals. Heifer calves from the two-way crosses were likewise heavier than those of the straightline matings, but heifers of the three-way matings tended to be inconsistent in their weaning weights when compared to the other two systems. With limited numbers of synthetic variety calves available from only one calf crop, it is not possible to draw any conclusions as to how this mating system might compare to the other three schemes. During the year that the synthetic variety calves were produced, their average weaning weight was slightly below that of the two and three-way cross calves.

Postweaning information is available on one crop of calves, but with limited numbers of bulls in the two and three-way crosses on test, these results are not meaningful yet.

VI. Application of findings:

Crossbreeding results have indicated that productivity of beef cattle herds can be increased by crossing beef breeds. Advantages in calf crop percentage at weaning, maternal ability contributing to calf growth, and calf growth due to hybrid vigor were indicated. Preliminary estimates indicate that these combined advantages should result in an increased gross return of about \$14 per year per cow exposed in the breeding herd. The use of Brown Swiss breeding in the crossbreeding study demonstrated that added milk producing ability in beef herds can make an additional contribution to preweaning growth of calves and that this early growth advantage can be reflected in weights at about 12 and 18 months of age.

The genetic-environmental interaction study is a relatively long term study that will indicate the extent to which adaptation of cattle to a given environment influences the level of product productivity.

Use of sires from different generations by artificial insemination has indicated that beef cattle lines can be improved genetically through inbreeding and selection. Additional data will be collected before the final evaluation is made.

Preliminary evaluation of existing data indicated that dams produced by crossing inbred lines showed maternal advantages over straightline dams as indicated by preweaning growth and weaning grade of calves produced. The weight advantage shown by steer calves from linecross dams tended to be reflected in final weight at the end of 196-day feedlot tests.

VII. Work planned for the future:

Continue processing the postweaning growth data and carcass data from Phase 1 of the crossbreeding study.

Evaluate data from Phase 2 of the crossbreeding and line-crossing projects.

Complete the collection of data from the study of genetic progress in Line 10. Prepare data from Lines 1 and 10 for evaluation.

Proceed with a study of the effects of cow size. Existing data will be used for this study.

Continue all other projects according to project plans.

VIII. Publications and manuscripts:

Pahnish, O. F., J. S. Brinks, J. J. Urick, B. W. Knapp, and T. M. Riley. 1969. Results from crossing beef x beef and beef x dairy breeds: calf performance to weaning. J. Animal Sci. 28:291-299.

Pahnish, O. F., B. W. Knapp, J. J. Urick, J. S. Brinks, and F. S. Willson. 1969. Postweaning performance of first-cross heifers. (Abstract. Submitted for annual meeting of American Society of Animal Science.)

IX. Project summary:

U. S. Range Livestock Experiment Station

Cattle Inventory - June 1969								
Breed				Hereford				
Line	L1 ¹	L4	L6	L9	L10	L12	L14	Flor- ida
Purebred				Purebred				
Bulls (12 mo. or over)	24	6	7	15	4	12	11	18
Cows (2 yrs. or over)	100	15	18	17	17	36	35	42
Heifers (yearlings)	34	4	9	8	5	13	13	22
Calves:								
Bulls	40	7	9	6	8	15	18	20
Heifers	44	5	2	5	5	18	13	21

Cattle Inventory - June 1969								
Breed	Hereford	Charo-lais	Angus	Hereford ²	Cross-bred ³	Hereford	Charo-lais	Angus
Line		Char. PB	Angus PB	Line-cross	Cross-bred	Pur-chased	Pur-chased	Pur-chased
Purebred or grade	Grade	PB	PB	PB	Grade	PB	PB	PB
Bulls (12 mo. or over)	9	0	5	23	25	4	4	5
Cows (2 yrs. or over)	121	14	22	65	184	--	--	--
Heifers (yearlings)	46	8	5	47	73	--	--	--
Calves:								
Bulls	59	7	12	30	78	--	--	--
Heifers	50	6	8	26	92	--	--	--

¹Includes animals from GEI project.

²All linecross animals resulting from crosses of lines 1, 4, 6, 9 and 10.

³All crosses of A, H, C and BS breeds.

U. S. Range Livestock Experiment Station

Cow Production Data - 1968 calf crop				
Project	Crossbreeding			
	Phase 3			
Breeding	Straight-bred matings ^a	Two-way rotation ^a	Three-way rotation ^a	Crossbred dams-BS ^b
Number cows bred to calve:				
As 2-yr.-olds	8	8	10	2
Number calves born from:				
2-yr.-olds - Alive	6	4	8	2
- Dead	0	0	0	0
Number calves weaned	5	4	8	2
Percent calf crop - Born	75.0	50.0	80.0	100.0
- Weaned	62.5	50.0	80.0	100.0

Prewaning Performance - 1968 calf crop				
Birth weight - Bulls	64	68	80	--
- Steers	81	--	92	87
- Heifers	78	77	78	--
Weaning age - Bulls	--	209	196	--
- Steers	202	--	197	203
- Heifers	198	199	196	--
Weaning weight - Bulls	--	458	478	--
- Steers	459	--	466	500
- Heifers	344	381	432	--
Adjusted weaning wt. (180 days) - Bulls	--	404	446	--
- Steers	418	--	434	453
- Heifers	319	352	403	--
Weaning score:				
Conformation - Bulls	--	81	80	--
- Steers	80	--	81	83
- Heifers	75	77	82	--

^aRepresenting H, A and C breeds.

^bH, A or C sire x ABr. Swiss or HBr. Swiss or CBr. Swiss dams.

U. S. Range Livestock Experiment Station

Cow Production Data - 1968 calf crop

Project	Crossbreeding			
	Phase 3			
Breeding	Straight-bred dams ^a	Two-way rotation ^a	Three-way rotation ^b	Synthetic variety ^c Beef x Beef
Number cows bred to calve:				
At 3 yrs. and up	59 ¹	55 ²	28	55
Number calves born from:				
3-yr.-olds and up - Alive	45	53	25	56
- Dead	1	0	0	0
Number calves weaned	45	51	24	55 ³
Percent calf crop - Born	78.0	88.3	89.3	101.8
- Weaned	76.3	85.0	85.7	100.0

Prewaning Performance - 1968 calf crop

Birth weight - Bulls	81	84	93	86
- Steers	83	84	91	91
- Heifers	79	80	87	80
Weaning age - Bulls	199	197	190	203
- Steers	195	198	189	201
- Heifers	196	198	193	204
Weaning weight - Bulls	476	498	528	514
- Steers	449	475	491	515
- Heifers	452	453	496	494
Adjusted weaning wt. (180 days) - Bulls	440	461	504	467
- Steers	420	440	472	472
- Heifers	422	428	468	446
Weaning score:				
Conformation - Bulls	81	83	83	83
- Steers	81	82	84	84
- Heifers	81	82	83	83

^aRepresenting H, A and C breeds.

^bH, A or C sire x HBr. Swiss, ABr. Swiss or CBr. Swiss dams.

^cRepresenting two-breed crosses of H, A or C dams bred to AxC and HxC sires.

¹Ten cows sold 11-17-67; computed on basis of 59 remaining cows.

²Five cows sold 10-31-67; computed on basis of 60 remaining cows.

³Fifty-six calves weaned; percentage based on 55 head. One calf stiffled.

U. S. Range Livestock Experiment Station

Cow Production Data - 1968 calf crop

Project	GEI Study			AI Sires Genetic Progress	
	Hereford Florida	Hereford Closed Line 1	Hereford Control Line 1	Hereford 3425 & 5681	Hereford 459 & 771
Breeding					
Number cows bred to calve:					
At 3 yrs. and up	50 ¹	71 ²	20 ³	40 ⁴	40 ⁵
Number calves born from:					
3-yr.-olds and up - Alive	38	41	14	20	30
- Dead	2	2	1	0	0
Number calves weaned	37	40	13	20	29
Percent calf crop - Born	88.9	70.5	78.9	51.3	76.9
- Weaned	82.2	65.6	68.4	51.3	74.4

Preweaning Performance - 1968 calf crop

Birth weight - Bulls	80	82	83	--	--
- Steers	--	--	--	93	85
- Heifers	77	82	80	84	78
Weaning age - Bulls	189	184	180	--	--
- Steers	--	--	--	180	176
- Heifers	190	193	188	172	179
Weaning weight - Bulls	426	426	430	--	--
- Steers	--	--	--	427	407
- Heifers	399	431	434	385	360
Adjusted weaning wt. (180 days) - Bulls	410	417	428	--	--
- Steers	--	--	--	427	411
- Heifers	381	407	419	399	359
Weaning score:					
Conformation - Bulls	81	78	79	--	--
- Steers	--	--	--	83	83
- Heifers	80	80	81	81	80

¹Five cows sold on 10-31-67; computed on basis of 45 remaining cows.

²Ten cows sold 10-31-67; computed on basis of 61 remaining cows.

³One cow sold 10-31-67; computed on basis of 19 remaining cows.

⁴One cow sold 10-31-67; computed on basis of 39 remaining cows.

⁵One cow sold 10-31-67; computed on basis of 39 remaining cows.

U. S. Range Livestock Experiment Station

Cow Production Data - 1968 calf crop

Line	L9	L12	L14	Carcass
Breeding	Hereford	Hereford	Hereford	Hereford
Number cows bred to calve:				
At 3 yrs. and up	27 ¹	42 ²	43 ³	63 ⁴
Number calves born from:				
3-yr.-olds and up - Alive	16	30	27	37
- Dead	0	1	2	0
Number calves weaned	14	29	27	35
Percent calf crop - Born	88.9	85.1	87.9	72.5
- Weaned	77.8	80.5	81.8	58.6

Prewaning Performance - 1968 calf crop

Birth weight - Bulls	77	91	89	86
- Heifers	68	85	81	78
Weaning age - Bulls	180	193	191	195
- Heifers	192	196	196	199
Weaning weight - Bulls	373	430	423	450
- Heifers	357	404	415	430
Adjusted weaning				
wt. (180 days) - Bulls	371	408	402	422
- Heifers	340	376	388	395
Weaning score:				
Conformation - Bulls	81	81	84	83
- Heifers	80	81	83	82

¹Nine cows sold on 10-31-67; computed on basis of 18 remaining cows.

²Three cows sold on 10-31-67; one sold on 11-28-67; two sold on 11-17-67; computed on basis of 36 remaining cows.

³Eight cows sold on 10-31-67; one sold on 11-17-67; one sold on 11-28-67; computed on basis of 33 remaining cows.

⁴Ten cows sold on 10-31-67; one sold on 11-17-67; one missing and presumed dead; computed on basis of 51 remaining cows.

U. S. Range Livestock Experiment Station

Cow Production Data - 1968 calf crop						
Project	Maternal Study		Mating Systems			
	Phase 2		Phase 3			
	Linecrossing		Linecrossing			
Breeding	Hereford	Hereford	Str.	Two-way	Three-way	S.V.
	St. line dams ^a	Linecross dams ^a	line dams ^b	rotation- al dams ^c	rotation- al dams ^c	Crossline dams ^d
Number cows bred to calve: At 3 yrs. and up	12 ¹	41	93 ²	25 ³	25 ⁴	12 ⁵
Number calves born from: 3-yr.-olds and up -						
Alive	8	35	58	17	17	11
Dead	0	0	0	0	0	0
Number calves weaned	8	35	54	17	17	11
Percent calf crop - Born	72.7	85.4	74.4	68.0	77.3	100.0
- Weaned	72.7	85.4	69.2	68.0	77.3	100.0

Prewaning Performance - 1968 calf crop						
Birth weight:						
Bulls	82	78	77	81	86	84
Heifers	73	76	78	79	75	78
Weaning age:						
Bulls	185	194	195	194	194	201
Heifers	190	194	193	195	201	192
Weaning weight:						
Bulls	338	418	398	439	446	448
Heifers	352	405	384	418	410	383
Adjusted weaning wt. (180 days):						
Bulls	332	394	372	413	419	410
Heifers	337	382	364	391	376	365
Weaning score - Conformation:						
Bulls	79	81	81	85	83	82
Heifers	79	81	81	83	83	82

^aRepresenting lines 1, 4, 6, 9 and 10.

^bRepresenting lines 1, 4, 6 and 10

^cLinecross dams of lines 1, 4, 6 and 10 bred to straightline 1, 4, 6 and 10 sires.

^dLinecross dams of lines 1, 4, 6 and 10 bred to a 4x1 linecross sire.

¹One cow sold 10-31-67; computed on basis of 11 cows remaining.

²Thirteen cows sold 10-31-67; two sold 11-17-67; computed on basis of 78 cows remaining.

³Five cows sold 10-31-67; computed on basis of 20 cows remaining.

⁴Two cows sold 11-17-67; one sold 10-31-67; computed on basis of 22 cows remaining.

⁵One cow sold 10-31-67; computed on basis of 11 cows remaining.

U. S. Range Livestock Experiment Station

Postweaning Performance - 1968 calf crop

Project	Line Development			
Breeding	Record of Performance			
Line	Purebred Line 9	Purebred Line 12	Purebred Line 14	Grade Carcass
Sex	Bull			
Method of feeding	Group - Feedlot			
Number on test	6	14	13	20
Average age on test	196	208	209	211
Initial weight	389	446	465	455
Initial score:				
Conformation	81	81	85	83
Days on test	196	196	196	196
Average daily gain	2.58	3.01	2.87	3.01
Final weight	895	1036	1028	1045
Final score:				
Conformation	78	83	81	83

Postweaning Performance - 1968 calf crop

Project	Genetic-environmental Interaction		
Breeding	Record of Performance		
Line	Purebred Line 1 (Closed)	Purebred Line 1 (Control)	Purebred Florida
Sex	Bull		
Method of feeding	Group - Feedlot		
Number on test	18	8	13
Average age on test	197	196	204
Initial weight	430	449	430
Initial score:			
Conformation	79	83	81
Days on test	196	196	196
Average daily gain	2.71	2.54	2.63
Final weight	961	947	944
Final score:			
Conformation	82*	84**	81

* Seventeen scored.

** Seven scored.

U. S. Range Livestock Experiment Station

Postweaning Performance - 1968 calf crop

Project	Maternal Study	
Breeding	Phase 2	
Line	Hereford ¹	
	Linecrossing	
	By	By
	Straightline dams	Crossline dams
Sex	Bull	Bull
Method of feeding	Group - Feedlot	Group - Feedlot
Number on test	4	14
Average age on test	201	210
Initial weight	392	438
Initial score:		
Conformation	79	81
Days on test	196	196
Average daily gain	2.76	2.83
Final weight	934	994
Final score:		
Conformation	81	81

¹Representing lines 1, 4, 6, 9 and 10

Postweaning Performance - 1968 calf crop

Project	Mating Systems			
Breeding	Phase 3			
Line	Hereford			
	Linecrossing			
	Straightline	Two-way	Three-way	Synthetic
	matings ¹	Rotation ²	Rotation ²	Variety ³
Sex	Bull			
Method of feeding	Group - Feedlot			
Number on test	25	7	10	5
Average age on test	211	210	211	217
Initial weight	410	449	460	469
Initial score:				
Conformation	80	85	83	82
Days on test	196	196	196	196
Average daily gain	2.60	2.67	2.81	2.78
Final weight	919	973	1011	1013
Final score:				
Conformation	81*	83	83	81

*Twenty-four scored.

¹Representing lines 1, 4, 6 and 10

²Linecross dams of lines 1, 4, 6 and 10 X straightline 1, 4, 6 and 10 sires.

³Representing two-linecross dams of lines 1, 4, 6 and 10 bred to 4x1 sire.

U. S. Range Livestock Experiment Station

Postweaning Performance - 1968 calf crop

Project Breeding Line	Mating Systems Phase 3			
	Crossbreds			
	Crossbreeding			
	Straight- bred ¹	Two-way Rotation ¹	Synthetic Variety ²	Brown Swiss Crossbreds ³
Sex	Bull			
Method of feeding	Group - Feedlot			
Number on test	13	13	13	8
Average age on test	214	213	219	205
Initial weight	493	505	546	544
Initial score:				
Conformation	81	82	83	84
Days on test*	112	112	112	112
Average daily gain*	2.87	2.90	2.90	3.14
112 day weight	814	830	870	896
Final score*	--	--	--	--

*Test not completed. Based on 112 days.

¹Representing H, A and C breeds.

²Representing two-breed crosses of H, A or C dams bred to AxC or HxC sires.

³A, C or H sire x ABS, CBS or HBS dams.

Postweaning Performance - 1968 calf crop

Project Breeding Line	Mating Systems Phase 3			
	Crossbreds			
	Crossbreeding			
	Straight- bred ¹	Two-way Rotation ¹	Synthetic Variety ²	Brown Swiss Crossbreds ³
Sex	Steer			
Method of feeding	Group - Feedlot			
Number on test	14	11	13	7
Average age on test	213	214	217	209
Initial weight	459	484	524	516
Initial score:				
Conformation	80	82	84	84
Days on test*	112	112	112	112
Average daily gain*	2.61	2.63	2.93	2.62
112 day weight	751	779	852	810
Score*	--	--	--	--

*Test not completed. Based on 112 day weights.

¹Representing H, A, and C breeds.

²Representing two-breed crosses of H, A or C dams bred to AxC or HxC sires.

³A, C or H sires x ABS, CBS or HBS dams.

U. S. Range Livestock Experiment Station

Postweaning Performance - 1968 calf crop		
Project	Artificial Insemination ¹	
Breeding	Hereford	
Line	Line 10 sires (459 & 771) ² x grade dams	Line 10 sires (3425 & 5581) ³ x grade dams
Sex	Steer	
Method of feeding	Group - Feedlot	
Number on test	14	8
Average age on test	193	196
Initial weight	403	425
Initial score:		
Conformation	83	83
Days on test*	196	196
Average daily gain*	2.66	2.80
196 day weight	924	974
Score*	--	--

*Test not completed.

¹ Estimating genetic gain by use of frozen semen from bulls of different generation intervals.

² Sire 459 born in 1951; sire 771 born in 1955.

³ Sire 3425 born in 1963; sire 5581 born in 1965.

UNIVERSITY OF NEVADA

- I. Station: Nevada Agricultural Experiment Station
- II. Project title: Interactions between genotype and environment in selection for economically important traits in Hereford cattle (304).
- III. Personnel:
 - Experiment Station:
C. M. Bailey (Project Leader), J. E. Hunter, D. M. Morris and C. R. Torell
 - U. S. Department of Agriculture, Agricultural Research Service, Fort Collins, Colorado:
Bradford W. Knapp, Acting Investigations Leader
- IV. and V. Work done this year and summary of progress:

Selection for single characters was continued in closed Hereford lines at the Main Station Field Laboratory, Reno and at the Knoll-Creek Field Laboratory near Contact, Nevada. A total of 140 calves was tested at the two locations during 1968-69. Performance data are reported in the project summary.

Preliminary analyses were made of genetic trends in postweaning traits of calves tested since the selection experiment was initiated in 1955. Final analyses will be completed this summer.

A feeding trial was conducted to evaluate the effects of energy level on the feedlot performance of bulls in the lines which have been developed at the Main Station Field Laboratory, Reno. Following completion of the standard 140-day postweaning test, random groups of bulls in each line were fed either 1% or 2% body weight equivalent of concentrate plus grass hay ad libitum until a live weight of 1000 lb. was attained. The specific gravity technique was used for estimation of body composition. Replicate trials are in progress.

A feasibility study was made on the relative energy conversion and body composition of young bulls and steers at different stages of development. Random samples of calves of each sex condition were slaughtered at weaning to establish initial body composition. Additional bulls and steers (untreated and stilbestrol-treated) from the same herd were slaughtered at 725 lb. or at 900 lb. live weight. A second trial in this series will be completed in 1970.

Analyses of data from pilot studies on the effects of genetic-environmental interactions on selection responses were completed. Six lines of rats were developed under two nutritional regimens. Three of the lines received ad libitum a commercial laboratory diet for six

generations; the other lines were fed ad libitum a restricted diet consisting of 45% cellulose: 55% commercial diet during the postweaning period (28 to 70 days). Mass selection was practiced for increased post-weaning growth rate in two of the lines on each diet and two lines served as controls. Realized heritabilities of postweaning growth rate were $0.38 \pm .11$ and $0.32 \pm .09$ for commercial diet select lines and $0.17 \pm .10$ and $0.28 \pm .10$ for replicate select lines on the restricted regimen. Top-gaining, select line sires produced in the final generation were subsequently mated with control dams on both diets. Progeny received the same diet from 28 to 70 days as their dams had during that period. Overall means, selected linear comparisons of least-squares constants and standard errors for progeny test data are reported in table 1.

Table 1. Overall means, selected linear comparisons of least-squares constants and standard errors for 28-day weight, postweaning gain and 70-day weight^a

Trait	Overall mean ($\hat{\mu}$)	Sire Line Diet ^b	Sire Line Diet X Progeny Diet ^c
28-day weight, gm.			
Male	76.5	0.2 ± 1.5	-1.0 ± 1.5
Female	69.5	0.4 ± 1.2	-1.1 ± 1.3
Postweaning gain, gm. ^d			
Male	178.2	$7.2^{**} \pm 2.5$	$-.6 \pm 2.4$
Female	98.4	$7.0^{**} \pm 1.6$	0.6 ± 1.5
70-day weight, gm.			
Male	254.8	$7.4^{**} \pm 3.2$	-1.7 ± 3.2
Female	167.9	$7.4^{**} \pm 1.9$	$-.5 \pm 2.0$

^aValues on a per-unit basis. N = 507 males, 499 females.

^bDifference (regular minus restricted) between progeny of regular diet and restricted diet sires.

^cInteraction of Sire Line Diet (regular minus restricted) with Progeny Diet (regular minus restricted).

^dPostweaning gain 28 to 70 days of age.

**P < .01

The results of feeding trials which were conducted in conjunction with the progeny evaluation (N = 288) indicated that progeny of sires developed on the commercial laboratory diet were more efficient as compared to those sired by breeding stocks with a history of selection under restricted feeding. Sire line differences in percent dry matter, percent ash, and kcal. energy per unit of carcass tissue at 28 and 70 days of age were nonsignificant. Effects of sire line X nutritional regimen interaction on postweaning performance were of little or no important in this study.

VI. Application of findings:

Final conclusions concerning the beef cattle studies are not justified at this time.

The results of the small animal studies indicate that selection for postweaning growth rate was more effective on a "regular" diet than under conditions of restricted feeding. Specific adaptation effects of sire lines on progeny performance were minimal. In this study, both diets were offered ad libitum. Thus, factors such as appetite, feed capacity and utilization of nutrients may have had a similar role in selection for growth rate under both nutritional regimens.

VII. Work planned for the future:

The beef cattle selection experiment will be revised this year. Some of the lines will be discontinued.

Feasibility studies on bull beef production will be completed.

VIII. Publications and manuscripts:

Hammack, S. P. 1968. Performance and body composition of young bulls in closed Hereford lines. M.S. Thesis. University of Nevada, Reno.

Hammack, S. P. and C. M. Bailey. 1968. Carcass composition and energy utilization of young bulls in Hereford lines. J. Animal Sci. 27:1126. (Abstr.).

Bailey, C. M. 1969. Some aspects of bull beef production. Proc. Annual Nevada Livestock Conf. 15:1.

IX. Project summary:

Nevada Agricultural Experiment Station

Cattle Inventory - June 1969						Total
Breed			Hereford			
Line ¹	1	2	3	4	5	
Purebred or grade			Purebred			
Bulls (12 mo. or over)	6	6	-	7	7	26
Cows (2 yr. or over)	43	39	-	45	40	167
Heifers (yearlings)	8	6	-	5	6	25
Calves - Bulls	17	13	-	16	14	60
- Heifers	10	11	-	12	10	43

¹ Lines 1, 2, and 3--irrigated pastures; Lines 4 and 5--range conditions.
Line 3 discontinued 1969.

Cow Production Data - 1968 calf crop						Total or average
Number cows bred to calve:						
At 3 yr. and up	41	42	36	36	35	190
Number calves born from:						
3-yr.-olds and up - Alive	35	32	30	27	24	148
- Dead	2	2		2	3	9
Number calves weaned	33	31	30	25	24	143
Percent calf crop: ²						
Born	85	76	83	75	69	78
Weaned	80	74	83	69	69	75

² $\frac{\text{Calves born alive/weaned}}{\text{Cows exposed to bull}} \times 100$

Prewaning Performance - 1968 calf crop						Average
Weaning age - Bulls	234	237	240	225	227	233
- Heifers	226	239	223	229	216	227
Weaning weight ³ - Bulls	444	432	448	359	397	416
- Heifers	373	411	390	350	326	370
Average inbreeding - Bulls	9	8	6	7	7	7
- Heifers	11	6	5	8	6	7

³ Unadjusted weaning weight

Nevada Agricultural Experiment Station

Postweaning Performance - 1968 calf crop						Total or average
Breed	Hereford					
Line ¹	1	2	3	4	5	
Sex	Bull					
Method of feeding	Individual feedlot					
Number on test	17	21	19	14	13	84
Age on test, days	253	255	259	247	249	253
Initial weight, lb.	445	437	460	378	410	425
Length of test, days	140	140	140	140	140	140
Daily gain, lb.	2.10	2.13	2.21	1.21	1.40	1.81
Gain, lb./100 lb. TDN ²	22.5	23.7	22.9	16.5	18.2	20.8
Final weight, lb.	740	735	769	548	606	680
Final score:						
Conformation ³	84	84	84	-	-	84.
Inbreeding, percent	9	8	6	7	7	7

Postweaning Performance - 1968 calf crop						Total or average
Breed	Hereford					
Line ¹	1	2	3	4	5	
Sex	Heifer					
Method of feeding	Individual feedlot					
Number on test	15	9	11	9	11	55
Age on test, days	245	258	242	251	238	247
Initial weight, lb.	380	416	401	375	331	381
Length of test, days	140	140	140	140	140	140
Daily gain, lb.	1.57	1.51	1.54	1.10	1.09	1.36
Gain, lb./100 lb. TDN ²	19.5	18.7	18.6	15.9	16.8	17.9
Final weight, lb.	600	628	615	529	484	571
Final score:						
Conformation ³	84	85	85	-	-	85
Inbreeding, percent	11	6	5	8	6	7

¹ Progeny in Lines 1, 2 and 3 received 2 parts grass hay:1 part concentrate. Lines 4 and 5 received 3 lb. alfalfa pellets plus grass hay ad libitum.

² Not adjusted for body weight.

³ Scores from 100 (outstanding) to 67 (cull).

NEW MEXICO STATE UNIVERSITY

- I. Station: New Mexico Agricultural Experiment Station
- II. Project title: Inheritance of heart defects and evaluation of factors affecting production and anomalous traits in beef cattle.
- III. Personnel:
 - Experiment Station:
 - L. A. Holland, Project Leader, A. L. Neumann and E. E. Ray
 - U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado
 - Bradford W. Knapp, Acting Investigations Leader
- IV. and V. Nature and extent of work done this year and summary of progress:

The ventricular septal defect was not observed in calves born dead or dying before weaning. Neither was it observed in cows removed from the herd for various reasons and slaughtered in a local slaughter plant.

Heritabilities, phenotypic and genetic correlations were computed for feedlot, non-carcass components and carcass traits of 137 Hereford steers. Means and heritabilities of these traits are shown in Table 1. Heritability estimates for the non-carcass components have not been reported in the literature. Genetic and phenotypic correlations between non-carcass components and live traits are listed in Table 2. These correlations have not been reported previously.

Twenty-nine breeding age females in the Old Line were transferred from the farm to the College Ranch. Inbreeding coefficients range from .30 to .49. The Old Line will be continued as a closed line on the College Ranch. Hopefully, other stations will use bulls from this line in top crossing studies.

VI. Application of findings:

The ventricular septal defect and the patent ductus arteriosus defect are apparently not simply inherited. Their occurrence in a breeding herd should not necessitate a change in the breeding program.

VII. Work planned for the future:

The New Mexico contributing project to W-1 terminates June 30, 1969. Publications from data collected in the project will be forthcoming and credited to W-1.

VIII. Publications and manuscripts:

Aguilar, Franco Agustin, 1968. Heritabilities, genetic and phenotypic correlations of non-carcass components, live and carcass traits. M. S. Thesis. NMSU Library, Las Cruces, New Mexico.

Table 1. Means, Standard Deviations and Heritabilities of Traits

Trait	Unit	Mean	S.D.	Heritability
Shrunk Slaughter Weight	lb.	811	64.8	
Non-Carcass Components				
Head	lb.	25.7	2.3	.11
Hindshanks	lb.	7.2	.6	.10
Hide	lb.	73.6	7.5	.11
Total digestive tract (with contents)	lb.	122.7	17.4	.31
Liver	lb.	9.3	.9	.00
Heart	lb.	3.0	.4	.55
Lungs & esophagus	lb.	10.1	2.2	.12
Dressing Percent	%	60.5	1.8	.12
Fat Thickness	in.	.45	.13	.00
Av. Daily Gain	lb.	2.03	.26	.35
Length of Body	in.	49.6	7.2	.14
Live Slaughter Grade	Score	17.4	.9	.00
Carcass Length	in.	74.6	4.3	.17
Carcass Grade	Score	17.2	.3	.10
Loin Eye Area	sq. in.	10.2	1.2	.04

Table 2. Genetic (r_G) and Phenotypic (r_P) Correlations Between
Non-carcass Components and Live Traits.

		Av. daily gain	Length of body	Live slaughter grade
Head	r_G	-.48	<u>2/</u>	<u>2/</u>
	r_P	.32	.42	.39
Hindshanks	r_G	<u>1/</u>	-.04	<u>2/</u>
	r_P	.45	.47	.48
Hide	r_G	.09	-.29	<u>2/</u>
	r_P	.36	.42	.45
Total digestive tract	r_G	<u>1/</u>	<u>1/</u>	<u>2/</u>
	r_P	.38	.36	.31
Heart	r_G	.81	.50	<u>1/</u>
	r_P	.25	.32	.24
Lungs & Esophagus	r_G	-.64	-.54	<u>1/</u>
	r_P	.08	.00	.17

1/ computed $r > 1$

2/ computed $r < -1$

IX. Project Summary:

New Mexico Agricultural Experiment Station

Cattle Inventory - June 1969				Total
Breed		Hereford		
Line	Old	XL	Linecross ¹	
Purebred or grade		Purebred		
Bulls (12 months or older)	9	0	0	9
Cows (2 years or over)	43	4	7	54
Heifers (yearling)	11	0	0	11
Calves - bulls	11	2	1	14
- heifers	15	2	2	19

¹ Linecross cows resulted from mating of Old Line bull with XL cows in the test of inheritance of the ventricular septal defect.

Cow Production Data - July 1, 1967 to June 30, 1968 calf crop			
Breeding Group	Old	XL	Ventricular
Number Cows bred to calve:			
As 2-yr.-olds	2	0	0
At 3 yr. and up	22	4	13
Number calves born from			
2-yr.-olds - Alive	1		
- Dead	1		
3-yr.-olds and up - Alive	19	3	12
- Dead	0	0	1
Number calves weaned	19	2	12
Percent calf crop ² - Born	88	75	100
- Weaned	79	50	92

² Number of calves born or weaned/number of cows exposed x 100

Preweaning Performance - July 1, 1967 - June 30, 1968 calf crop			
Birth weight - Bulls	77	66	70
- Heifers	68	63	70
Weaning age - Males	240	240	240
- Females	240	240	240
Weaning weight - Bulls	522	356	511
- Steers	446		410
- Heifers	434	427	412
Weaning score:			
Conformation - Bulls	7.4	5.0	7.0
- Steers	6.8		6.5
- Heifers	6.6	7.0	6.7
Condition - Bulls	11.0	10.0	10.6
- Steers	11.0		10.5
- Heifers	10.8	10.0	11.2

OREGON STATE UNIVERSITY

- I. Station: Oregon Agricultural Experiment Station
- II. Project title: Diallel crossing in beef cattle and its use in breed improvement.
- III. Personnel:

Experiment Station:

Ralph Bogart, Project Leader, W. H. Kennick, K. E. Rowe,
George Blanks, and John Mailhes

U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado

Bradford W. Knapp, Acting Investigations Leader

IV. Nature and extent of work done this year:

1. Bred cows in the establishment of a synthetic lines based on our 1 x 2, 1 x 3 and 2 x 3 bulls and cows. The third crop of calves is starting to arrive. Bred cows by A.I. in the establishment of a second synthetic line based on our 1 x 2, 1 x 3 and 2 x 3 cows and U. S. Range Livestock Station 1 x 4, 1 x 10 and 4 x 10 bulls. The third crop of calves is starting to arrive.
2. Continued the Angus line as a 2-sire and 20-cow closed herd.
3. Continued the testing of linecross cows for calf producing ability by mating them all to one and the same Angus bull. The last matings for this part of the study were made in 1968 and data on the 1969 calves will provide data for analyses of the 4-year study.
4. Prepared material for publication on a study using mice in which selection for a lowly and a highly heritable trait was practiced under levels of 0, 25, 50 and 100 r x-irradiation.
5. Continued the comparison of elite with index selection in mice. Litter size, birthweight, weaning weight and post-weaning gains are the traits under selection in mice. The index was constructed from data obtained on the populations prior to the selection studies to develop the genetic parameters and the economic importance of the traits was based on the assumption that the traits were of equal value.
6. Prepared and submitted to Journal of Animal Science, a paper on Liver Nicotinamide Nucleotide Coenzymes in relation to lean and fat of the carcass, growth rate and thyroid size.

V. Summary of progress and conclusions to date:

1. The effects of X irradiation on quantitative genetic traits were investigated by comparing the response of irradiated mice to selection for litter size and 28-day weight with the response to selection for the same two traits in non-irradiated lines. Irradiated lines were maintained at three levels of X irradiation, 25r, 50r, and 100r, administered to both males and females immediately before pairing. No matings were made later than 14 days after irradiation so that only the effects of X irradiation upon the post-meiotic stages of gametogenesis were studied. The lines receiving 50r and 100r were all lost by the fourth generation of selection. An interaction of genetic and physiological factors was assumed to be responsible for the reduced fertility leading to the termination of these lines. Selection response for litter size was negative in five of the six irradiated lines. This was attributed to reduced selection differentials due to lower fertility and to reduced heritability due to physiological masking of the additive genes for litter size. It appears that the accumulation of deleterious recessive genes also may have played a role in reducing heritability in the irradiated lines. Selection response for 28-day weight was positive in four of the six irradiated lines, although less than in the non-irradiated controls in most cases. Three of the irradiated lines had realized heritability values greater than either of the controls. Some increase in usable genetic variance for 28-day weight was indicated, although reduced selection differentials prohibited increased selection response.

2. 0, 25, 50 and 100 r whole-body x-irradiation was given to both male and female mice immediately before a two week breeding period. There were fewer litters produced by the irradiated mice. Litter size, however, for all litters born during a two-week period showed no between-treatment differences. Litters born to mice which mated during the first week after receiving 50 and 100 r were slightly above the overall mean while litters born to mice that were irradiated with 50 and 100 r one to two weeks before mating were significantly reduced. A control line in which only the males received 100 r failed to show this effect. Females in metestrus at time of irradiation produced larger litters while females irradiated with 50 and 100 r one full estrous cycle before mating produced significantly smaller litters. Eight months after irradiation, spermatogenesis in males receiving up to 100 r appeared histologically normal. Ovaries from females receiving 25 r showed a significant reduction in developing ova and corpora lutea while ovaries from females receiving 50 and 100 r were completely atretic and histologically sterile. No other significant endocrine effects with doses up to 100 r were found.

3. Liver tissue from 55 inbred and diallel crossed beef bulls, raised under standard conditions and slaughtered at 455 kg. bodyweight, were analyzed for all forms of oxidized and reduced nicotinamide nucleotide coenzymes. Results obtained indicate that NADPH was present

in excess over NADP^+ , while NADH was present in lower concentration compared to NAD^+ . Age at slaughter was positively correlated with percent fat in the carcass and with all the nicotinamide nucleotide coenzymes; whereas, it was negatively correlated with thyroid gland weight. Thyroid gland weight was negatively correlated with percent carcass fat and positively correlated with $\text{NADP}^+/\text{NADPH}$. The latter were negatively correlated with percent fat. Thyroid weight was also negatively correlated with the coenzymes which were positively correlated with fat deposit. Amount of carcass fat was positively correlated with those coenzymes that were negatively correlated with percent lean in the carcass.

4. Inbreeding was negatively associated with percent lean in the carcass, while it was positively correlated with total coenzymes, NADPH, and $\text{NADH} + \text{NADPH}$. These coenzymes were also negatively correlated with percent lean in the carcass and positively correlated with percent fat. Inbred animals showed a lower percent of lean in the carcass compared with line crosses. Linecross animals appeared to show better gain per day, lower feed per unit gain and lower levels of coenzymes than the inbreds. Significant differences were observed for gain per day, feed per unit gain and coenzyme levels for the average of parents compared with their offspring. The diallel analysis showed no general combining ability for any of the 21 observations studied. Specific combining ability and reciprocal effects, however, were shown to exist for production traits and various coenzymes.

5. A complete diallel cross among three inbred lines of Hereford cattle was conducted over a four year period, 1963-1966. Performance measurements consisting of birth date, birth weight, preweaning average daily gain, postweaning average daily gain, feed per unit gain, age at weaning, age at the end of the feed test, conformation scores and condition scores were collected on 102 males and 80 females of the Hereford breed. In addition, records of 33 males and 29 females of the Angus breed were included to obtain more accurate estimates of environmental effects on the various traits included in the study. Measurements of blood levels of creatinine, amino acid nitrogen and urea nitrogen were obtained at 204 and 340 kg. body weight among the females and at 204, 340 and 454 kg. bodyweight among the males. In addition, carcass traits, organoleptic measurements and endocrine gland weights were collected on 119 males. The carcass traits consisted of carcass conformation, maturity, marbling and grade; dressing percentage; percent fat, lean and bone in the 12th rib cut; loin-eye area and fat thickness over the 12th rib. Cooking and organoleptic measurements consisted of percent weight loss and percent drip in cooking as well as taste panel evaluations of tenderness, juiciness, flavor of the lean, flavor of the fat and overall organoleptic score. Endocrine gland weights consisting of the thyroid gland, adrenal glands, pituitary gland and testicles were obtained. The data on these traits were analyzed to obtain estimates of general combining ability, specific combining ability and reciprocal differences among the lines. Heterotic effects were

estimated by comparing each linecross plus its reciprocal with the appropriate mid-parent. Phenotypic correlation coefficients among all the traits were obtained to determine the relationship between the various performance traits, blood constituents, carcass traits, organoleptic measurements and endocrine gland weights. All traits were analyzed on a within-sex basis because of management differences between the sexes.

6. Males had larger birth weights and reached 227 kg. at younger ages than the females but no differences existed between sexes for preweaning rate of gain or conformation and condition scores at 227 kg. Angus calves had earlier birth dates, smaller birth weights, higher preweaning rates of gain, were younger at 227 kg. and had higher conformation and condition scores at 227 kg. than the Hereford calves. Among the males, general combining ability effects were nonsignificant for all preweaning and weaning traits except conformation score at 227 kg. Among the females, significant general combining ability effects were detected for preweaning rate of gain, age at 227 kg. and condition score at 227 kg. body weight. Line 1 was superior to lines 2 and 3 in general combining ability for these traits in both males and females. Specific combining ability effects were nonsignificant among both sexes except for birth weights of the 2 x 3 and 3 x 2 linecross females. Although the general and specific combining ability differences for preweaning and weaning traits were generally nonsignificant among the males, those crosses with line 1 involved were generally superior to other crosses. The inbreeding of dam effects on the males may have prevented general combining ability difference in growth rate to be detected since the milk production of the inbred dams may have been too low for the males to express their genetic differences in growth potential whereas, among the females, the level of milk production was sufficient to detect general combining ability differences.

7. Heterotic effects were small or nonexistent for most of the preweaning traits. However, a significant difference in favor of the linecross calves was obtained for percent stillbirths. No differences were detected for percent calves born, but the linecross calves were more vigorous at birth than the inbred calves. The Angus exceeded the Herefords in percent calves born and percent calves weaned ($P < .01$). No overall linecross superiority was detected among the six preweaning and weaning traits in either sex. However, negative heterosis was found for condition score at 227 kg. among the 2 x 3 and 3 x 2 linecross males and for birth weight among the 2 x 3 and 3 x 2 linecross females. General combining ability effects were significant or highly significant for feed efficiency, conformation score at 363 kg. and condition score at 363 kg. among the males. Among the females, significant or highly significant general combining ability differences were exhibited for conformation and condition scores at 340 kg. Significant specific combining ability effects were detected for postweaning rate of gain in both sexes. Reciprocal effects were unimportant for the postweaning traits. The line 2 males were superior in general combining ability for feed

efficiency while line 3 was inferior in general combining ability for conformation and condition scores. The lack of significant general combining ability effects for rate of gain would indicate that the lines were genetically very similar for this trait. Heterotic effects were significant for postweaning rate of gain and feed per unit gain among the females and for age at 363 kg. among the males. Heterosis was not found for conformation and condition scores in either sex.

8. General combining ability differences were significant or highly significant for carcass conformation, marbling, carcass grade, percent drip, tenderness, juiciness and thyroid gland weight. Line 1 excelled in carcass conformation, marbling, grade and thyroid gland weight whereas line 3 had a higher percent drip and excelled in juiciness and tenderness. Significant heterotic differences were detected only for testicle weight among the 1 x 2 and 2 x 1 line cross males. All other carcass traits, organoleptic measurements and endocrine gland weights did not exhibit heterosis. Thus, it would appear that most of the genetic variation is additive in nature for these traits.

9. For the entire study, it was concluded that line 1 was superior to lines 2 and 3 in general combining ability for most of the growth and carcass traits. Line 2 excelled in feed efficiency whereas line 3 was the poorest combining line for conformation and condition scores. Crosses of line 1 with the other lines generally resulted in larger heterotic effects for most of the growth traits. This might have been expected based on the history of the three lines. The development of three lines selected for the same traits and subjected to the same environmental influences likely prevented sufficient divergence among the lines for many significant combining ability or heterotic effects to be detected.

VI. Application of findings:

1. The studies at the Oregon Station show that although radiation appears to create more genetic variability, the reduced fertility resulting from irradiation limits selection so drastically that selection becomes relatively ineffective and, as a consequence, less improvement is made in lines in which irradiation is imposed than in closed lines. The results demonstrate that females become sterile following irradiation even at relatively low dosages because of permanent ovarian damage, whereas males show no reduction in fertility and testis damage is either not great or it is reparable.

2. It appears that liver nicotinamide nucleotide coenzymes that are associated with fat metabolism are associated with animals with lower thyroid activity, slow rate of gain and lower lean but greater fat deposition in the carcass of beef cattle. Inbreeding tended to reduce thyroid weight, rate of gain and lean percentage and to increase fat percentage of the carcass and the coenzymes associated with fat deposit. It is suggested that inbreeding may act by reducing thyroid output or by increasing enzymes affecting fat metabolism.

3. The greatest expression of heterosis resulting from linecrossing in beef cattle was in reduced mortality at or shortly following birth. Fertility and several of the other production traits were not greater in the linecross than in the inbred animals. There were some specific and general combining ability effects for production traits. It appears that all three types of gene action are important in beef cattle. The reduced mortality of the linecross calves at birth suggests simple Mendelian inheritance. Specific combining ability effects suggest either overdominance or epistasis while the significant general combining ability effects suggest additive gene control. Thus, it appears that in overall improvement one may need to employ mass selection and progeny testing for most effective results.

VII. Work planned for the future:

1. Continue the Angus line as a 2-sire and 20 cow population.
2. Continue the establishment of the two synthetic Hereford lines--one based on use of our 1 x 2, 1 x 3 and 2 x 3 bulls and cows and one based on our 1 x 2, 1 x 3 and 2 x 3 cows mated to 1 x 4, 1 x 10 and 4 x 10 U.S. Range Livestock Station bulls.
3. Complete the study on evaluation of calf producing ability of inbred and linecross cows and prepare the material for publication.
4. Complete the study on elite versus index selection in mice and prepare the material for publication.
5. Establish base physiological and production parameters for the two synthetic lines of Herefords being established. Biweekly weights will be taken on all calves until weaning and weekly weights, daily feed consumption, and score for conformation at completion of the feed test will be obtained on each calf. Blood levels of urea and amino acid nitrogen and liver nicotinamide nucleotide coenzymes will be determined at weaning and at the end of the feed test. If help is available, liver biopsies at 100 lb. increments of weight will be obtained on some calves for coenzyme determinations to see what the coenzyme pattern is in the growing calf.

VIII. Publications and manuscripts:

Anwar-Afghan, Mhammad, Richard Bull, Ralph Bogart and James Womack. 1969. The relationship of liver nicotinamide nucleotide coenzymes to production traits in diallel crossed beef bulls. Oregon Agricultural Experiment Station Technical Paper #2622.

Humes, Paul E. 1968. Estimates of combining abilities, heterotic effects and phenotypic correlations among inbred lines of beef cattle and their linecrosses. Oregon State University Ph. D. Thesis.

Womack, James. 1968. Effects of radiation on selection progress in mice. Oregon State University Ph.D. Thesis.

Womack, James and Ralph Bogart. 1968. September-October. Effects of irradiation on selection response in mice. Journal of Heredity 59(5):269-274.

Womack, James and Ralph Bogart. 1969. Effects of x-irradiation on size of litters born to female mice irradiated at various stages of the estrous cycle. International Journal of Fertility.

IX. Project summary:

1. Heritability estimates of .38 for feed intake and of .65 for chronic bloating were obtained. Cattle that eat more per unit of body weight gain more rapidly. It has been shown that the heritability of performance traits is highest under a good level of feeding than when animals are fed to make little gains during the winter.

2. Rate of post-weaning gain is highly correlated with feed efficiency. Bulls gain more rapidly than heifers but consume no more feed per unit body weight than heifers; consequently, they are much more efficient. Efficiency of feed use declines as calves increase in weight. Feed consumption increases as calves increase in bodyweight but feed consumed per unit bodyweight declines with increasing weight.

3. Nitrogenous blood constituents have been shown to be related to rate and efficiency of gains and to size of animals. Rapidly gaining and efficient animals are lower in blood amino acid and urea nitrogen and excrete less urea through the urine than slowly gaining animals. They resemble younger animals compared with older ones in that young animals also have lower blood levels of amino acid and urea nitrogen. It appears that rapidly gaining animals have the capacity to withdraw amino acids from the blood stream to build muscle tissue; whereas, slowly gaining animals are faced with a problem of elimination of amino acids. They deaminize the amino acids, excrete the nitrogenous portion as urea, and use the carbonaceous portion as a source of energy. Thus, the slowly gaining animals have a higher proportion of fat in comparison with the lean in the carcass than rapidly gaining calves at the same weight (1000 lb.).

4. Since it appeared logical that enzymes are concerned with protein synthesis or fat deposition, studies have been made on the phosphatase and transaminase enzymes of the blood which should be related to muscle and/or bone growth; and the nicotinamide dinucleotide coenzymes of the liver which are concerned with the production of fat. It was not possible to find any association of transaminase activity with rate of efficiency of gains. The more

rapidly gaining animals were higher in phosphatase activity. Also, animals that showed less variation on phosphatase activity were generally the more rapidly and efficiently gaining ones. There was an interesting relation of the coenzymes in that cattle that were high in the coenzymes gained slowly, were less efficient, stored more fat and less lean and had smaller thyroid glands than cattle that had low liver values for the coenzymes.

5. It has been shown that hemoglobin per unit volume of blood, content per red cell, or concentration increase as calves increase in size and that rapidly gaining and efficient animals are lower in hemoglobin than slowly gaining animals. Males are generally lower in hemoglobin than females at the same weight.

6. Normal EKG patterns for beef cattle have been established and the best leads for obtaining satisfactory EKG recordings have been ascertained. With this background of information, it was possible to describe the electrocardiographic pattern in certain diseases such as the W-P-W syndrome, briskett edema and certain heart anomalies. The change in EKG pattern from birth has also been described and the effects of certain environmental factors such as feeds, temperature, etc. have been determined.

7. An analysis was made from the data collected over a 12-year period on three lines of Herefords and one of Angus. The Hereford lines were one-sire and 15 cow lines while the Angus line was a two-sire and 20 cow line. Performance initially improved, after which there was a plateau which was later followed by a decline in the three Hereford lines. Slow but continuous improvement has occurred in the Angus line. There was unconscious selection against inbreeding. Preweaning traits were more adversely affected by inbreeding than post-weaning traits. In fact, rate and efficiency of post-weaning gains were not adversely affected by inbreeding until high levels were obtained.

8. Assays of pituitaries from steers fed a low-protein diet and steers fed a normal diet showed no effects of diet on thyrotrophic hormone content.

9. The phenotypic relationship among performance traits and several of the environmental factors that affect performance traits have been established.

10. The performance of top-cross calves sired by bulls of three inbred lines showed that the traits that characterized the lines generally were expressed in the top-cross offspring. For example, one line was very efficient and calves sired by bulls of this line were also quite efficient in feed use.

11. A complete diallel cross among the three inbred lines of Hereford cattle was conducted over a four-year period. Most of the preweaning traits showed no general combining ability effects from crossing. There was a marked difference in per cent of calves that were born alive and survived which was in favor of the linecross calves even though all of them were produced by inbred dams. The fertility level was the same whether inbred or linecross matings were made.

Oregon Agricultural Experiment Station

Cattle Inventory - June 1968					Total
Breed Line	Hereford		Crossbred	Angus	
	1 s	2 s			
	Non-				
Purebred or grade	Purebred	reg. pure.	Crossbred	Purebred	
Bulls (12 mos. or over)	3	3	1	2	9
Cows (2 yrs. or over)	19	14	21	18	72
Heifers (yearlings) 1 - 2	--	--	22	3	25
Calves - Bulls	14	3	21	9	47
- Heifers	4	5	15	12	36

Cow Production Data - 1968 calf crop					Total
Number cows bred to calve:					
As 2-yr.-olds	--	--	22	3	25
At 3 yrs. and up	19	14	21	18	72
Number calves born from:					
2-yr.-olds - Alive	--	--	16	3	19
- Dead	--	--	0	--	0
3-yr.-olds and up - Alive	18	8	20	18	64
- Dead	0	0	0	1	1
Number calves weaned	18	8	36	21	83
Percent calf crop - Born	94.7	57.1	83.7	104.8	86.6
- Weaned	94.7	57.1	83.7	100.0	85.6

Preweaning Performance - 1968 calf crop					Average
Birth weight - Bulls	75.4	83.7	63.7	68.8	72.9
- Heifers	75.7	75.0	60.0	56.0	66.7
Weaning age - Males	179.0	170.7	200.8	165.7	179.0
- Heifers	167.0	167.5	199.0	169.6	175.8
Weaning weight - Males	424.7	417.3	395.8	440.4	419.5
- Heifers	382.2	385.2	376.1	371.2	378.7
Suckling gains - Males	1.97	2.02	1.62	2.20	1.95
- Heifers	1.84	1.81	1.58	1.88	1.78

Oregon Agricultural Experiment Station

Postweaning Performance - 1968 calf crop							Average or Total	
Breed	Hereford				Angus			
Line	1 s		2 s					
Sex	♂	♀	♂	♀	♂	♀	♂	♀
Method of feeding	Individual		Feedlot		Individ. Feedlot			
Number on test	14	4	3	4	9	12	26	20
Average age on test	192.4	175.0	191.7	179.2	174.1	164.0	186.1	172.7
Initial weight	450	400	450	400	450	400	450	400
Days on test	124.5	174.0	122.3	153.2	115.4	165.9	120.7	164.3
Average daily gain	2.79	2.07	2.81	2.27	3.02	2.12	2.87	2.15
Feed efficiency:								
TDN/100 lbs. gain	657	793	657	801	619.5	768.0	644.5	787.3
Final weight	810.9	763.2	805.3	758.5	822.4	758.2	813.0	775.8
Final score:								
Condition	12.1	12.7	12.0	13.1	12.1	12.5	12.1	12.4
Conformation	12.4	12.4	12.5	12.9	12.7	12.5	12.5	12.6

Suckling gains and post-weaning performance of 1968 calf crop							
Line	Sex	Number	Post				Condition
			Suckling Gain	Weaning Gain	Feed Efficiency	Conformation	
1	M	3	1.95	2.99	5.93	12.9	12.8
	F	1	1.61	2.04	7.96	12.5	13.2
2	M	1	1.98	2.79	6.34	13.5	12.8
	F	0	-	-	-	-	-
3	M	2	1.80	2.77	6.76	12.0	12.3
	F	0	-	-	-	-	-
1 x 2	M	5	1.83	2.74	6.56	12.2	11.6
	F	6	1.90	2.21	7.96	12.6	12.8
1 x 3	M	4	2.31	2.80	6.61	12.7	12.3
	F	1	1.80	2.11	8.05	13.3	13.3
2 x 3	M	2	1.89	2.62	7.41	11.6	11.3
	F	0	-	-	-	-	-
Angus	M	9	2.20	3.02	6.19	12.7	12.1
	F	12	1.87	2.12	7.68	12.5	12.5

UTAH STATE UNIVERSITY

- I. Station: Utah Agricultural Experiment Station
- II. Project title: Development of selection criteria for improvement of efficiency in growth and fattening in cattle.
- III. Personnel:

Experiment Station:

James A. Bennett, Project Leader, and Paul Fannesbeck

U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado

Bradford W. Knapp, Acting Investigations Leader

IV. Nature of work done this year:

New work was started as called for under the revised project. The emphasis is on efficiency measurements. The plan is to fully measure efficiency of meat production in Hereford and Charolais cattle. Since this was the first year under the new project, numbers of cattle of the desired kinds were somewhat limited. Measures of feed efficiency are underway with 11 Herefords, 5 Charolais x Shorthorn crosses and 2 Charolais calves. These calves were weaned at approximately 3 1/2 months of age, placed in individual pens and fed pellets plus limited amounts of long hay. These calves readily adapted to this kind of feed and have grown well.

The numbers are small and the results are preliminary at this stage. For the period from when the calves weighed approximately 375 pounds to when they weighed approximately 675 pounds, the Herefords have a slight advantage for gain per pound of feed. The crossbreds are intermediate. The tests are continuing.

The Charolais and crosses are from one sire and there is a feeling that he is not representative of the "best-doing" Charolais blood. Calves to be born in 1969 are from proven sires and additional Charolais cattle of demonstrated gaining ability will be added in 1969.

Digestion trials will be run in the near future with yearling Charolais and Hereford heifers.

Data accumulated under the previous project are being analyzed. Preliminary analysis of the Shorthorn data indicate that inbreeding, under a system of mild inbreeding accompanied by selection for weaning weight and postweaning growth, did not suppress birth weight or suckling rate of gain. More detailed analyses are underway.

A muscle tissue extracting device has been developed for extracting cores of the Longissimus dorsi muscle of live animals. A core of approximately 6 centimeters long and 1.75 cm. by 1.0 cm. are rapidly taken with minimal discomfort to the animal and with negligible danger of infection.

The Shorthorn herd was dispersed during the year.

V. Work planned for the future:

Digestion trials will be conducted with Hereford and Charolais yearling heifers in the very near future. Later in the year digestion trials will be run with mature cows on an all roughage ration.

Hereford and Charolais calves will be weaned at approximately three months of age and individually fed. Feed requirement per unit gain will be measured. At appropriate weights animals will be slaughtered and estimates obtained of carcass composition. Cooking tests will also be performed on meat from these animals and evaluations made for tenderness, juiciness and flavor.

VI. Publications and manuscripts:

None

VII. Project Summary:

Utah Agricultural Experiment Station

Cattle Inventory - June 1968			
Breed	Hereford	Charolais & Charolais crosses	Shorthorns
Bulls (12 mos. & over)	8	1	1
Cows (2 yrs. & over)	59	7	19
Heifers (yearling)	14	1	9
Steers (yearling)	8	0	3
Calves - Bulls	29	1	8
- Heifers	33	1	9

Utah Agricultural Experiment Station

Preweaning Performance - 1968 calf crop*

Breed	Hereford
Birth weight - Bulls	79.4
- Heifers	77.4
Weaning Age - Bulls	171
- Heifers	158
Weaning weight - Bulls	323
- Heifers	289
Adjusted weaning weight - Bulls	367
- Heifers	346
Weaning score:	
Conformation - Bulls	2.12
- Heifers	2.20
Condition - Bulls	3.81
- Heifers	3.96

*The Charolais and Charolais crossbred calves were weaned early for efficiency studies and are not included.

The Shorthorns were sold.

Postweaning Performance - 1968 calf crop

Breed	Charolais		Charolais			
	Hereford	Hereford	x	x		
			Shorthorn	Shorthorn	Charolais	Charolais
Line	Utah I	Utah I	-	-	-	-
Sex	Bulls	Bulls	Bulls	Heifers	Bull	Heifer
Method of feeding	Group	Individual	Individual	Individual	Individual	Individual
Number on test	14	9	3	2	1	1
Average gain on test	2.42	2.32	2.89	1.89	2.40	2.06

WASHINGTON STATE UNIVERSITY

- I. Station: Washington Agricultural Experiment Station.
- II. Project title: Comparison of breeding systems for improvement of beef cattle.
- III. Personnel:

Experiment Station:

C. C. O'Mary, Project Leader, Dan Coonrad, and J. K. Hillers

U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado

Bradford W. Knapp, Acting Investigations Leader

IV. Nature and extent of work done this year:

The following items were studied for distribution of variables over the period from 1957 through 1966.

Age of dam in months
Weight at beginning of feed test
Final test weight
Age at beginning of test
Average daily gain on test
Feed: lbs/100 lbs gain

A preliminary performance test program has been initiated with cooperators in the state. The University herd data from 1957 to the present is being used as a guide in establishing the program.

A new herd sire was purchased for use in group C.

V. Summary of progress and conclusions to date:

Year differences were very noticeable as overall weaning weights were lower in 1968 than in 1967 with the same sires being used in each group. No conclusions reached.

VI. Application of findings:

Caution should be exercised in drawing conclusions when weight gains are increased or decreased from year to year. For example, in this case the big differences were due to year effects and could not be attributed to genetic progress (loss or gain).

VII. Work planned for the future:

The relationship of all variables (listed in item IV) to feed efficiency will be determined over a 10-year period.

VIII. Publications and manuscripts:

O'Mary, C. C. 1968. Selecting your herd sire. Proceedings Beef Cattle Conference. Washington State University, Pullman.

O'Mary, C. C. 1969. Relationship of size and efficiency in beef cattle. Beef Cattle Day. Washington State University, Pullman. April 25, 1969.

IX. Project summary:

Washington Agricultural Experiment Station

Cattle Inventory - July 1968				Total
Breed	Angus			
Line	A	B	C	
Sire	TE6	436	A10	
Bulls (12 months or over)				36
Cows (2 years or over)	33	31	29	93
Heifers (yearlings)	10	11	15	36
Calves - Bulls	20	15	15	50
- Steers	0	0	0	0
- Heifers	11	16	11	38

Cow Production Data - 1968 calf crop				Total
Number cows bred to calve:				
As 2-yr.-olds	10	9	4	23
At 3 yr. and up	23	22	25	70
Number calves born from:				
2-yr.-olds - Alive	10	9	3	22
- Dead	0	0	1	1
3-yr.-olds and up - Alive	21	22	22	65
- Dead	0	0	0	0
Number of calves weaned	30	30	25	85
Percent calf crop ^a - Born	94	100	90	95
- Weaned	91	97	86	91

Prewaning Performance - 1968 calf crop				Average
Weaning age - Bulls	199	200	201	200
- Heifers	201	193	198	197
Weaning weight - Bull's	434	447	503	461
- Heifers	407	400	395	401
Adjusted weaning - Bull's	450	471	519	480
weight ^c - Heifers	420	433	410	421

^aIndicate method of calculation

^cIndicate method of adjustment $\frac{(W.W. - B.W.)}{age} \times 205 + B.W.$: Cow adj 15%, 10%, 5% for 2, 3 and 4 years, respectively

Washington Agricultural Experiment Station

Postweaning Performance - 1968 calf crop				Total or Average
Breed		Angus		
Line	TE6	436	A-10	
Sex		Male		
Method of feeding		Individual		
Number on test	10	11	11	32
Average age on test	240	240	240	240
Days on test	151	151	151	151
Average daily gain	2.11	2.48	2.35	2.31
Feed efficiency:				
Feed/100 lbs. gain	770	770	800	780
Final weight	845	902	936	894
Final score:				
Conformation	13	13	14	13.3

Postweaning Performance - 1968 calf crop				Total or Average
Breed		Angus		
Line	TE6	436	A-10	
Sex		Female		
Method of feeding		Individual		
Number on test	5	4	5	
Average age on test	240	240	240	240
Days on test	151	151	150	151
Average daily gain	1.72	1.77	1.53	1.67
Feed efficiency:				
Feed/100 lbs. gain	890	810	840	847
Final weight	713	731	674	706
Final score:				
Conformation	14	15	13	14

UNIVERSITY OF WYOMING

- I. Station: Wyoming Agricultural Experiment Station, Laramie, and Gillette Substation, Gillette
- II. Project title: Criteria for improving effectiveness of selection in beef cattle.
- III. Personnel:

Experiment Station:
George E. Nelms, Project Leader, R. A. Field and M. L. Riley, Animal Science Division; Leon Paules, Substation Division; Brinton Swift, Veterinary Science Division; and W. W. Ellis, Biochemistry Division.

U. S. Department of Agriculture, Agricultural Research Service, Fort Collins, Colorado
Bradford W. Knapp, Acting Investigations Leader
- IV. and V. Nature and extent of work done this year and summary of progress:

The effects of inbreeding on various cow weights were studied. Inbreeding levels were arbitrarily divided into 4 levels; 0.0 to 8.9, 9.0 to 14.9, 15.0 to 19.9 and 20% or over. Although differences became smaller as the cows became older the effects were never completely eliminated.

	Level of inbreeding			
	1	2	3	4
180 day wt., kg.	170 ^a	152 ^b	157 ^b	151 ^b
Yearling wt., kg.	302 ^a	282 ^b	276 ^{b,c}	267 ^c
18 mo. wt., kg.	368 ^c	359 ^b	352 ^b	346 ^b
30 mo. wt., kg.	434 ^a	408 ^b	401 ^b	400 ^b
42 mo. wt., kg.	464	438	451	452
54 mo. wt., kg.	512	477	491	--

a,b,c Numbers in the same row with different superscripts are significantly different at the .05 level.

The level of inbreeding of the dam did not significantly affect the weaning weight of their calves when the effects age of dam and cow weight were removed.

Prediction equations for cutability were developed for bull carcasses. Equations were developed for light weight carcasses, 480 to 570 lbs. and heavy bull carcasses, 575 to 850 lbs. Several useful equations were developed. However, the most practical equation for light weight carcasses was:

Retail cut-out, lbs. = $25.0 + .44$ (carcass wt., lbs.) + 2.95 (depth round, cm.) + 4.24 (area 1. dorsi, sq. in.) - 1.87 (fat depth, mm.) - $.60$ (kidney fat, lbs.). $R^2 = 0.62$; S.E. = 11.7. For the heavy carcasses the most practical equation was: Retail cut-out, lbs. = $27.2 + .73$ (carcass wt., lbs.) - 4.42 (fat depth, mm.). $R^2 = 0.94$; S.E. = 12.2.

The equations for the light weight carcasses could be improved by including foreshank muscle:bone ratio; $R^2 = 0.80$, S.E. = 9.8.

Percent cut-out could not be predicted with desired accuracy in either group of carcasses.

Data collection and matings were continued as outlined in the project.

VI. Application of findings:

The prediction equations obtained from this study make it possible to obtain cutability data without mutilating the carcass. This is particularly valuable if sires are to be selected for carcass desirability.

It would appear that the weaning weight depression observed in calves from inbred cows is in part explained by the depression in the weight of the dam.

VII. Work planned for the future:

Continue as outlined in the project.

VIII. Publications and manuscripts:

Ammerman, E. E. 1968. Effects of inbreeding on cow weights and production. M. S. Thesis. University of Wyoming, Laramie..

Nelms, G. E., C. O. Schoonover and M. K. Drake. 1968. Predicting the muscle:bone ratio of bull carcasses. Am. Soc. Animal Sci. West. Sect. 19:211.

Nimmo, R. A. 1969. Predicting cutability in bull carcasses. M. S. Thesis. University of Wyoming, Laramie.

IX. Project Summary:

Wyoming Agricultural Experiment Station

Cattle Inventory - June 1969					Total
Breed	Hereford	Hereford	Hereford	Angus	
Line	Gillette	Growth	Carcass	Laramie	
Purebred or grade	Purebred	Purebred	Purebred	Purebred	
Bulls (12 mos. or over)	4	1	0	0	5
Cows (2 yrs. or over)	28	29	23	31	111
Heifers (yearlings)	7	10	11	10	38
Calves - Bulls	16	19	8	12	55
- Heifers	15	15	9	14	53

Cow Production Data - 1968 calf crop					Total
Number cows bred to calve:					
As 2-yr.-olds	9	6	3	8	26
At 3 yrs. and up	30	38	28	34	130
Number calves born from:					
2-yr.-olds - Alive	7	3	2	8	20
- Dead	0	1	1	0	2
3-yr.-olds and up - Alive	25	31	19	24	99
- Dead	1	0	2	2	5
Number of calves weaned	32	34	17	28	111
Percent calf crop ^a - Born	85	80	77	81	81
- Weaned	82	77	55	67	71

Preweaning Performance - 1968 calf crop					Average
Birth weight - Bulls	72	82	81	67	75.5
- Heifers	69	76	75	55	68.8
Weaning age - Bulls	185	202	202	204	198
- Heifers	183	206	194	194	194
Weaning weight - Bulls	370	426	445	438	420
- Heifers	347	413	401	382	386
Adjusted weaning weight ^c - Males	363	388	406	400	389
- Heifers	343	371	378	360	354
Average inbreeding - Males	.176	1.1	2.7	15.8	---
- Heifers	.189	2.8	0	14.8	---

^aIndicate method of calculation calves weaned/cows exposed.

^cIndicate method of adjustment for age only (180 days).

Wyoming Agricultural Experiment Station

Postweaning Performance - 1968 calf crop

Breed	Hereford		Hereford	
Line	Gillette		Growth	
Sex	Bulls	Heifers	Bulls	Heifers
Method of feeding	Group		Group	
Number on test	16	15	18	14
Average age on test	192	192	210	204
Initial weight	364	351	425	424
Days on test	168	168	168	168
Average daily gain	2.49	1.41	2.61	1.50
Final weight	783	588	864	676
Average inbreeding	.186	.186	0	0

Postweaning Performance - 1968 calf crop

Breed	Hereford		Angus	
Line	Carcass		Laramie	
Sex	Bulls	Heifers	Bulls	Heifers
Method of feeding	Group		Group	
Number on test	8	7	10	10
Average age on test	205	199	210	202
Initial weight	445	415	438	390
Days on test	168	168	168	168
Average daily gain	2.70	1.58	2.43	1.56
Final weight	898	681	846	653
Average inbreeding	6.0	6.0	11.5	12.0

P R O J E C T R E P O R T S

PROJECT REPORTS

Arizona:

Dr. Roubicek:

The progeny from the Station bulls on test this year are doing very well. Overall performance was 3.17 for 140-day gain test. It may not mean much except some people saw that it was on low concentrated rations. We had no problem of illness except one case of bloat.

We are continuing the analysis of blood constituent data that we accumulated sometime ago. On the first page of the report I have some of the heritability estimates for blood constituent data. The numbers in each age group are rather large, as I recall about 600 observations. The low heritability values are not strictly due to poor sampling, apparently we are just now picking up true sire differences because of the tremendous year effect that we find in the blood constituent data such as creatinine, uric acid, and other cases in point.

Question:

Will you use the same bulls this year?

Dr. Roubicek:

We will use the same ones again.

California:

Mr. Wagnon:

We have two projects. First there was the one on crossbreeding which is being phased out in regard to the last calf crop. In fact this is the last calf crop. We had one heifer that is going to be weaned in a couple of months so they have already started working up the data. That will be phased out with the next calf crop. Dr. Rollins is using project cows from that study to accumulate stocks for his study on double muscling. Dr. Rollins is over in Europe studying this problem further, using Charolais in France. The stock that we have accumulated are mainly Angus. We started out with a few Charolais. Besides breeding them we are purchasing them when we can find them. This last year we got 11 heterozygous and 10 double-muscle females from a purebred herd in Idaho from three different lines of Angus breeding. So mainly we are still trying to accumulate sufficient stocks.

We have started several studies on the few that we are developing. I will just list them: growth and development, the problem of going on the offset of puberty in relation to the development of muscle, we have some nutritional studies and metabolism studies. Our new meats man is working on muscle enzymes. Of course, we are working on carcass analysis. Some steers that we were working on were slaughtered last year and are still going through the chemical lab. We have people working on difficult parturition in double-muscled animals, problems of breeding, and variation of anatomy.

Colorado:

Dr. Brinks:

The work again this year was just getting our data in shape for future analyses. Using Mr. Knapp's inbreeding program we got all the back inbreeding work done by computer. We have a new calf card format completed. We are now working on 28-day postweaning gain and efficiencies, which will be put on cards.

The first study in the report is the comparison of steer line-cross progeny by our Station inbred sires with Colorado rancher progeny. The program is sponsored by the Colorado Cattlemen Association, Colorado BCIA, the University, Monfort Packing Plant, etc. All ranchers in Colorado who are interested can put progeny groups or even samples of their herd into this particular test and they get back feedlot gain data and fairly complete carcass information. This is our third year on the program. The table on page 2 of the report gives the comparison for the last 2 years. The first year we tested some of our Prospector inbred sires and the second year a few of our inbred Tarrington sires and one Prospector-San Juan cross sire. Our linecross progeny did very well in comparison with the ranchers' cattle. I thought we were going to give up a little research data by putting these cattle in this program, but I think it is going to project a lot of good as far as demonstration-extension work. There certainly are more ranchers asking about our work at the Station since we have done this.

One of the other studies that I will mention briefly is data from the commercial Angus ranch. One of our graduate students looked at repeatability which turned out to be fairly low in this particular Angus herd--about .25. He was also comparing different methods of adjusting records--records taken from the herd itself versus those recommended in the Baker Report. Apparently it didn't make a whole lot of difference which correction terms were used in this particular herd--whether the industry factors or those from the herd itself. There is a general article on this which will be out next month, and it will explain why we think repeatability is quite low in this particular herd.

A study on the effect of early bunched calving in the optimum season certainly shows that the commercial ranchers can increase weaning weights by getting them early in this optimum season and getting them bunched. Those calves born during the first 20 days average 17 days earlier and 41 lbs. heavier than overall herd average based on a 90-day breeding season. This advantage was due primarily to older calves at weaning time, but it also showed that they gained faster from birth to weaning. We also looked at the cow's lifetime productivity as influenced by the date of her first calving. Those cows that calve early the first time continue to calve earlier in subsequent years and to wean heavier calves in subsequent years. Those that conceived soonest after they were put in always turned out to be the better mothers in lifetime production. I would like to see some real good studies on how early we can breed these heifers. I think the rest of the material under that study is self-explanatory.

One of our more interesting studies during the year was the environmental and genetic factors affecting cow productivity. We looked at genetic and environmental factors during the heifer's preweaning phases to see how these affect the future productivity as measured by her MPPA values that were based on weaning weights of her calves. Some of the environmental factors that we looked at were her birth year, differences in years in weaning weights, and how this affects the future productivity. Also we used age of dam as an environmental category. Line of sire we thought was primarily genetic, while line of sire of dam in our particular setup was primarily environmental. The cow's inbreeding and her dam's inbreeding were included in the model along with actual weaning weight, weaning age, and weaning score. The overall results show that these heifers can have too high a preweaning plane of nutrition. This shows up very definitely for birth years and also for age of dam categories. It may change some of our management recommendations. This material is more fully explained in our Annual Beef Cattle Improvement Day and Auction Report. A diagram in the report shows actual weaning weight mean versus MPPA by age of dam of cow. It shows that our most productive cows are coming out of our first and second calve heifers plus our very old cows which I think relates to this lower plane of nutrition which they had as calves.

Dr. Bogart:

Since your productive animals are from your young cows and very old cows, couldn't this just be a matter of selection? There may be more high selection in the young heifers that were kept as replacements, and your old cows were kept for their producing ability.

Dr. Brinks:

No, we didn't have very much cow selection. I wouldn't say there was none, but there wasn't very much. We had heifer selection but not based on their productivity, it was just based on weaning

weights and yearling weights. I don't think selection could be a major thing here, because we have heifers from two-year old cows and three-year old cows all the way through this thing for 22 years. Hopefully they are getting bigger and better, but we still are taking this into account. I don't think selection could be a big thing here.

Dr. Bogart:

Do you think selecting for better productivity at weaning then automatically gives you poorer cows from the standpoint of their own production?

Dr. Brinks:

Correlations between weaning weight and most probable producing ability are zero essentially in this data and also in the Miles City data. This means the weaning weight is a very poor predictor of a cow's future productivity. I think we are selecting cattle that are carrying genes for better maternal ability but they have been affected environmentally.

Dr. Bogart:

This bothers me because I interpret it that the better environment is negatively associated with how it is going to affect what they produce. Weaning weight also is an indication of a better environment. Therefore, if we select for better weaning weight, we ought to get a very good producing cow. I think we should ignore weaning weight and go to postweaning weight.

Dr. Brinks:

I think we can still differentiate between getting light weaning weights under a lower environmental regime.

Dr. Butts:

I have a comment that may be pertinent to this subject. We just completed the analysis of the accumulated Front Royal data. Whether in a direct fashion or empirical fashion in looking at the growth rate of their condition scores in future productivity, there is a correlation in the model. We didn't see very much significance in three breeds and two sections of those six subgroups. The gain regression coefficients were consistently positive and consistently negative on condition which we interpreted to mean if we modify the weaning gain for this indication of preweaning environment, then we would come back to a positive situation where we select on birth weight. It doesn't separate genetic category, but at least there is the possibility that it isn't all mechanical but just a misleading situation.

Dr. Brinks:

There is enough data accumulated from several years' study all over the country that shows this negative environmental effect, so I think it is definitely there. I think this is one reason we are getting these very high negative genetic correlations between maternal ability and growth rate. Preliminary evidence indicates that when we leave the regression of offspring on dam out of these various equations and estimate the covariances of maternal ability and growth rate, the negative correlation jumps down from a $-.7$ or $-.6$ to $-.2$. I think all of the published estimates (Cook's early work, Hill's, and Hohenboken's Thesis) indicate a very high negative correlation. If we leave out the regression of offspring on dam, these drop down to a $-.2$ rather than a very high one.

Dr. O'Mary:

We attempt to adjust the young and old and I was just wondering if you might happen to be off consistently one way here.

Dr. Brinks:

I don't think we are because we got quite a little data that these adjustment factors are based on plus our age of dam after making the adjustment, and the other categories are pretty level.

Dr. Cramer:

The reason this is such a voluminous report is that it is the final report of four years' work. We actually don't have all the data completely analyzed yet, but we do have a large part of it included here. For this report we were granted some W-1 money to study the heritabilities and some of the relationships and interactions of lipid composition in beef cattle using W-1 cattle. We did serum lipid analysis, intramuscular lipid analysis, and subcutaneous fat analysis on samples collected from most of the states in the Western Region. The main use of all this data I believe is predicting whatever it is that we want to predict in the carcasses of beef cattle. Not having any information on any of the cattle, particularly carcass information, there isn't any real use that I can make of the data as far as W-1 is concerned. The data poses some very interesting questions to me from a fat metabolism standpoint, but I won't take any time to go into that because it isn't pertinent to this meeting. The best use you can make of the data is to take it home with you and see if there are any relationships between some of these correlations and heritability estimates with your own data.

We do have a lot of means, the first nine tables are just means by station. If any of you do want individual animal data on your own cattle to do any analysis or to run any correlations with some

of your carcass data, just drop me a letter and I will be happy to send you copies of the raw data.

Tables 10 and 11 show the interrelationships of various lipid components between tissues of Hereford cattle utilizing phenotypic correlations. The analysis of variance (Tables 12 - 15) show a large number of significant and highly significant differences between sires within stations and station differences.

Following the analysis of variance we have a table of genetic correlations and a table of heritability estimates. The serum phospholipids, cholesterol, and cholesterol esters have a high heritability, while the free fatty acid had a low heritability. This is an indication of the metabolism of fats; the serum free fatty acids are a function of the energy state of the animal and therefore have a low heritability. The serum triglycerides are a function of the dietary state and the amount of fat in the diet. I would say 95% of serum triglycerides are a direct absorption from the gut; therefore, they will have a low heritability. The components that are synthesized in the liver will have a high heritability. We have heritability estimates on the types of fats that are synthesized in the bile juice.

What do these mean? What can we do with them? What do we want to do with all this? We want to see if we can predict anything that will improve the carcass. With these high heritabilities we ought to be able to predict something. I don't have the data to compare with or to run any correlations on except intramuscular fat. On Table 10 the correlations are fairly low for blood serum constituents and intramuscular fats. The correlation of serum cholesterol ester with intramuscular fat is about .16, while the heritability for cholesterol esters is .3. There may be a possibility of using a blood serum analysis in predicting such things as the amount of marbling in the muscle, and there may be other things that we can predict.

The only other thing that I want to mention is on Table 17 on genetic correlations we have some fairly respectable correlations between intramuscular fat and serum lipids. Perhaps these correlations are of such a magnitude that just determining the amount of fat in the blood may be a pretty good estimation of the marbling fat in the muscle.

Hawaii:

Dr. Cobb:

We are proceeding along the same lines that we had before. We are still collecting data on calves from AI work. We still haven't gotten a satisfactory calf crop under the AI program. I will withhold giving any data out on that until we have collected the remainder of the information. The numbers are so small and I think people tend to jump to conclusions on small numbers, and start putting out information when they shouldn't. I prefer not giving it out until we get it all collected.

We are progressing with the crossbreeding work very well. We are getting some very interesting results that agree quite well with crossbreeding work elsewhere. As you know we are using Charolais, Hereford, and Angus bulls on Hereford and Angus cows. The Charolais look much better in the second and third years than they did in the first year. The second and third year we used the Miles City bulls. We are very well pleased with the crossbred calves that we got out of those Miles City bulls. We have only slaughtered cattle from the second year which would be the first year we used the Miles City bulls. The carcass data and feedlot data pleased us very much on the performance of the Charolais-cross cattle. We have even had one or two choice crossbred Charolais off the grass without any supplement, which goes against what our feedlots think of Charolais.

We did do some data analysis, and it is explained in the report. We are beginning to get some computer programs to work and they are changing our computer again so we will have to convert again. We have made quite a bit of progress in that regard during the year. We hope to spend most of the coming year cleaning up the data that has been collected and run it through the computer and finish the analysis of data that has been collected under the project. We are very optimistic that we can get this done since the computer program seems to be working.

The major analysis that we just finished was on the postweaning data on the records that we have collected in cooperation with Hawaiian Ranch Company. In general it indicates that good progress should be made on postweaning weights and gains from birth to yearling and birth to twenty months. Gain from weaning to twenty months has not as good heritabilities. Our scores that we put on our cattle seem to have very low heritabilities. This would indicate that we are not doing a very good job of grading cattle or that the heritability is low anyway and that we would not be expected to make much progress on that trait especially on yearling score. We did an analysis of carcass information probability and edibility of meat. We were very discouraged to find that we didn't have any sire differences in the analysis so we didn't bother to go into too much of a complete breakdown in that data. In general all of the traits had very small sire components of variance and these were not significant.

Dr. Brinks:

Just one question on your GEI part of this. Did you finalize that last year or would you just give us one statement on the importance that you found?

Dr. Cobb:

No, we are going to run another analysis since we got this program that will handle interaction. We did analyze part of it by the new program and got the same results in general that we did before except on one trait. We had an error on specific gravity before, and we no longer get a sire by gene interaction on specific gravity. We still get the same results on all the other traits as before. We definitely got a distinct difference in rank in the sires in the feedlot and pastures on most of these studies even though they are not significant in most cases.

Idaho:

Dr. Christian:

This past year we completed a summary of our seven years of project test work that we have been doing at the station. This represents a total of 38 different sires from our own herd. Over the years we have had anywhere from 3 to 9 sires represented in the progeny groups that we fed out for a total of 285 calves. We just completed the analysis of data on this particular phase of the study. The analysis indicates that there are tremendous year differences in the performance of the calves that we had on feed. This point will make it very difficult to combine the data over a 7-year period. Another thing that we have done in many of our measurements, both in the live animal and in the carcass, is to attempt to use curvilinear regressions. We find that these increase the predictability of the regression very little over the linear in the prediction of the carcass traits.

The Idaho cattlemen this past year started a progeny testing station at our Caldwell Station. At the present time they have offspring from some 12-14 different sires on feed there. I expect that we will find a tremendous year and herd variation. We will have this data available for us.

Dr. Orme has been doing work on physiological maturity. The first year's work was on the basis of age--that is slaughtering the calves on the basis of age at slaughter rather than weight at slaughter. The age groups are 300, 350, 400, 450, and 500 days. He got such a tremendous variation that he decided to go strictly on a weight constant basis. I don't have any data available on that because the calves aren't all slaughtered on this particular part.

Dr. Roubicek:

What weight range did he use?

Dr. Christian:

He started out with slaughtering one day a week. He tried to get them as close as possible, he tried not to go under 50 lbs. There might be a 20 lb. variation. This involves a complete dissecting job which is a tremendous amount of work.

Montana:

Dr. Blackwell:

Two analyses of data have been done this last year. One a PhD Thesis by one of our staff members was completed at Texas A&M, and one was a Master Thesis at Bozeman primarily on carcass information.

We are continuing the laboratory analysis of milk samples that we got a few years back from the U.S. Range Livestock Experiment Station. The man who is working on this with Dr. El Negoumy has found another band of protein on the electrophoresis, which could be another class of protein.

We are making our third linecross mating this year at the Havre Station among the five lines there. This is the last time we will make these reciprocal linecross matings. We plan to maintain the heifer progeny from these until we have good information on their calf producing ability.

We are planning at the Bozeman Station to initiate crossbreeding work. Mr. Burfening will probably head this up; we will use Hereford, Angus, and some of our dairy breeds. We are planning a rather extensive change with the work at Bozeman. One thing he wants to do in particular is to examine the response to hormone therapy for multiple births in cattle and see if we can get at some extensive approaches there.

U. S. Range Livestock Experiment Station:

Dr. Bellows:

The physiology program is largely reproductive physiology. A study has just been completed on the effects of the plane of wintering on the age at puberty and subsequent performance in crossbred heifers. The study involved Angus-Hereford reciprocal crossbred heifers that were produced by artificial insemination so we had actual birth dates and actual ages.

The study was set up with three different winter-gain groups. Gain group 1, 2, and 3 were set up with 30, 29, and 30 heifers respectively. These animals were fed during the 150-day wintering period which is from about December 1 until May 6, so they would gain a target gain of .5, 1, or 1.5 pounds a day. The gains that we obtained of 0.61, 0.99, and 1.49 pounds were quite close to our goals. These were maintained on average quality alfalfa hay throughout the wintering period, and the average consumption for Group 1 was 10.2 pounds of hay, Group 2 was 10.6 pounds of hay and 1.9 pounds of grain, and Group 3 was 11.4 pounds of hay and 4.4 pounds of grain. Those that gained more slowly during the wintering period, gained more rapidly during the summer period. I might point out that these heifers were wintered in feedlots so the amount of feed intake could be controlled.

Then on May 6, which was the date that we had 6 inches of new growth on the cool season grass, they were all turned together in the same pasture. From this point we are measuring carry-over effect of a wintering plane of nutrition. The average daily summer gain from May 6 until weaning on October 15 was 1.32 pounds, 1.15 pounds, and 0.92 pounds for Groups 1, 2, and 3 respectively. The end winter weights ranged from 414 pounds for the low to 558 pounds for the highs. The beginning breeding weight on June 15 for these heifers, even though they were gaining rapidly, was still only 458 pounds for Group 1 as compared to 527 pounds and 584 pounds for Groups 2 and 3. At the end of the weight study in October they still hadn't caught up, Group 1 was 629 pounds as compared to 667 pounds and 708 pounds for Groups 2 and 3. So there is a definite effect on the growth of the animal at least in body weight differences.

Table 1
Relationships Among Weight Gains and Reproductive
Performance in Beef Heifers

	Winter Gain Group		
	1	2	3
Number heifers	30	29	30
Avg. winter gain (lb./day)	0.61	0.99	1.49
Feed required:			
Hay	10.2	10.6	11.4
Grain	-	1.9	4.4
Avg. summer gain (lb./day)	1.32	1.15	0.92
Body wt. (lb.)			
End winter	414	481	558
Begin breed.	458	527	584
October	629	667	708

The average age at puberty was highly different as shown in Table 2. The table also indicates the percent of heifers in each group that were in heat prior to the breeding season, during the breeding season, and after the breeding season. This is an accumulation of those that were particularly fertile or that had the possibility of conceiving. Those that came in heat after the breeding season, which of course had no chance of conceiving, were 20%, 3%, and 0%. The pregnancy percentages in October were 50% for Group 1, 86% for Group 2, and 87% for Group 3. The percent that were not bred were the same as those after breeding season 20%, 3%, and 0%. There was a marked effect of plane of nutrition on age of puberty and subsequent reproductive performance.

Table 2. Relationships Among Weight Gains and Reproductive Performance in Beef Heifers (Miles City)

	Winter 1	Gain 2	Group 3
Number heifers	30	29	30
Avg. age pub. (days)	434	412	388
% in heat:			
Prior to breed. season	7	31	83
During breed. season	73	55	17
After breed. season	20	3	0
% bred and conceived during:			
1st 20 days	30	62	60
2nd 20 days	10	21	20
3rd 20 days	10	3	7
% preg. Oct.	50	86	87
% not bred	20	3	0

Another area that we are working on is other critical nutritional periods. The data from the Station here as far as range livestock production is concerned indicates that a very critical nutritional period is when the cow is suckling the calf early in the season when snow is on the ground and there is very little forage available. We had a study that involved 57 cows that were maintained in the feedlots during the calving period. We obtained immediate post-calving weights from these cows, then they were turned out into a pasture that we thought had adequate grass. The average calving date was April 12; the cows were then reweighed on May 12. For the 30-day period they were on range pasture, there was no supplement supplied at any time except salt and bone meal. The weight change in the cows was -2.9 pounds per

day weight loss as compared to a weight gain of 1.6 pounds in the calves. We are asking the cow to maintain her body weight, produce milk, and reproduce on the limited amount of forage available in the early spring. On April 21, which was approximately midway in our weighing period, the forage moisture content was 82.1%. On May 5 the moisture content of the grass had gone down to 65.3%. The calf gains did not indicate a drop in milk production even though there was a loss of cow weight on the limited forage. The number of cows in the study was dropping because various cows were being put on breeding supplement. The weight gains from May 13 to June 14 was 1.3 pounds per day weight gain in the cows and 1.6 pounds in the calves, and our forage moisture content is now less than 50%. Then during the breeding season there were 16 cows on range forage with a gain of only 0.8 pounds per day, and the calves gained slightly more with a decrease in moisture content.

Table 3
Range Reproduction Summary

Time Period	No.	Wt. Change		Forage Data	
		Cows (lb.)	Calves (lb.)	Date	Water (%)
Calve - 5/12	57	-2.9	1.6	4/21	82.1
				5/5	65.3
5/13 - 6/14	30	1.3	1.6	5/19	43.2
				6/16	49.2
6/15 - 7/22	16	0.8	1.9	7/22	45.3
				8/3	35.0

The thing that we have found is summarized I think in some work that has been conducted by Dr. Houston and Mr. Urick in the use of early spring pastures. This has proved to be by far the most profitable and by far the most effective way of bridging the gap between calving and adequate native range forage. The cows were either assigned to native range or to improved spring pasture. In the improved spring pastures the average turn-out date was April 28, and they were maintained for approximately a six-week period prior to breeding. The cows received no supplement on the native range. The improved pastures were crested wheatgrass and Russian wild rye. The average daily gain during the spring pasture period over that six-week period that these cows were in the improved spring pastures was 1.76 pounds for those calves on native range compared to 2.14 pounds daily gain for the calves on the improved pastures. From birth to weaning there was a 1.67 pound gain on the native range as compared to a 1.76 pound gain on the improved pastures. This carry-over having an effect on the weaning weight was

416 pounds for calves from cows on native range as compared to 434 for those that were on the improved spring pastures on the six-week period prior to breeding. The weaning percentage was 81.3% as compared to 91%. Pounds of calf per cow is extremely important in terms of figuring the dollar and cents return (338 pounds as compared to 395 pounds). During the spring pasture period there was essentially no difference between the two groups, but a very definite carry-over effect in weight changes of cows on the native pasture during the breeding season. This was 65 pounds as compared to 111 pounds for those on the improved spring pasture.

Table 4
Response of Range Cows and Calves
To Improved Spring Pastures
(4 Years, Miles City)

	Spring Forage	
	Native Range	Improved Pasture
Calf data		
Da. gain		
Spr. past.	1.76	2.14
Brt. - wn.	1.67	1.76
Wn. wt.	416	434
% wn.	81.3	91.0
Lb. calf per cow	338	395
Cow gains		
Spr. past.	43	42
Breeding	65	111

I mentioned that we have studied supplement level. We can sum it up very easily in that we have not been able to produce results anywhere near this by grain supplementation at any time. Our data suggest quite strongly that we do a good job of depressing range forage consumption by high levels of grain supplementation on cows on native range or improved pasture.

We are working on factors affecting calf losses at birth or shortly after birth. This is data from 1963-68. I had the opportunity to work with a large herd and to look at the causes of death losses from cows from a highly inbred herd, a crossbred herd, and a linecross herd. I found some very interesting results, and I think you need to look at these because this is an important loss as far as the industry is concerned. From 1963-68 there have been 161 calves lost and this is considered as 100%. (That doesn't mean we lost all of the calves,

Table 5
Calf Losses at Birth
(Miles City, 1963-68)

	No.	%
Total lost	161	100
Male	92	57
Female	69	43
Normal	107	66
Abnormal	54	34
Lung status (normal calves only)		
Functional	54	51
Nonfunctional	53	49

Table 5
Some Effects of Breed Crossing on
Reproductive Performance
(Miles City)

Mating	Born %	Calf losses		Calf wn. %	Lb. calf	
		Brt. %	Brt./wn. %		wn. %	/cow
HxH	80.6	1.7	1.7	77.8	436	339
AxA	87.2	2.4	3.6	81.9	454	372
CxC	74.2	1.1	4.5	70.0	544	381
HxA + AxH	89.5	3.9	-	86.0	467	402
HxC + CxH	81.1	1.7	1.7	78.3	502	394
AxC + CxA	81.3	1.8	1.8	78.4	507	397
St. br.	80.0	1.7	3.5	75.9	478	363
X-br.	84.0	2.5	1.1	80.9	492	398

but the 100% is the total of the 161 calves that were lost during that period.) Ninety-two males and 69 females were lost for a 57% and 43% breakdown in this 100%. The losses were classified as normal or abnormal. The abnormal calves had either visceral or skeletal abnormalities that either caused or definitely contributed to the loss of the calf. In the

percentage difference between normal and abnormal 107 were normal and 54 were abnormal for a 66% and 34% breakdown. In the lung status for normal calves only 54 had functional lungs on autopsy and 53 had nonfunctional lungs for a 51% and 49% breakdown. Fifty-one percent were actually born alive and their lungs had functioned. Of these then we had 66% of those that were lost were normal and 51% of these had functional lungs and they were born alive.

As we go on to calf losses, the most common cause of loss in the normal calf was dystocia and for the most part this did include those that were backwards or that had an abnormal presentation, but this is a very small percentage of the loss. The rest of the autopsy findings were of delayed, slow, and difficult birth; edema around the head; drowning in the placenta fluid; bruises; and even broken bones. In many cases where these calves were born dead, they were lost only because of management procedure. There wasn't anyone there to help the calf during delivery. Premature was 3% lost. Unknown (those that had no dystocia, no abnormalities, or no known cause of death) was 10% lost. If you look at the abnormalities, 37% had some type of skeleton abnormality and 63% had organ abnormalities.

Table 7
Causes of Calf Losses at Birth
(Miles City - 1963-68)

Autopsy Findings	Lost	
	No.	%
Normal		
Dystocia	93	87
Premature	3	3
Unknown	11	10
Total	107	
Abnormal		
Skeleton	20	37
Organs	34	63
Total	54	

One of the techniques we use is measuring the pelvic opening. We go into the rectum and measure height of the pelvic opening and the width of the pelvic opening. The caliper that we use is a machinist's caliper from which we removed the jaws and smoothed all the sharp edges so we wouldn't injure the animal. We use a smaller one for pelvic measurements in heifers. One thing that we have found is that there is a very high association between external body measurements and the internal body measurements. We take the two measurements (the height and the width of the pelvic opening), multiple these two together, and use the resulting value. We find highly significant correlations among the variables for these external measurements and the internal

area. We have then calculated a prediction equation which is shown in Table 8. The equation was developed for three-year old Hereford heifers for precalving pelvic area, but it also is close for the two-year olds. This shows us that the same body size relationships exist between the two age groups of animals. Hip width is just the outside linear distance between the wings of the ilium, and rump length is from the point of the hip bone back to the pin bone.

Table 8
Pelvic Area Body Size Relationship
In Hereford Heifers
(Miles City)

Assoc. of pelvic area with:	r
Body wt.	0.53**
Hip width	0.41**
Rump length	0.48**

Prediction equation:	
0.08 x body weight plus	
5.98 x hip width plus	
4.83 x rump length minus	
2.52	
equals	estimate of
	pelvic area.

**P<.01

I have some data from a study in which we had Hereford and Angus heifers that were bred for reciprocal crossbred calves. Ninety-five of the Hereford heifers were bred to a single Angus bull by artificial insemination. The Angus heifers were inseminated from semen from a single Hereford bull. The body weight of these heifers is a precalving body weight that was obtained five days prior to the beginning of the 75-day calving season. Pelvic area showed no significant breed differences (247 for Herefords as compared to 251 for Angus). These measurements are in square centimeters. The birth weights for the male calves from the Herefords were 73 pounds and the Angus were 69 pounds, while the female calves weighed 68 pounds for the Herefords and 67 pounds for the Angus. Total calving difficulty percentage for the two breeds showed no significant difference. It was 44% for the Hereford and 50% for the Angus. The calving difficulty by sex of calve showed a highly significant difference (65% of the males experienced some type of calving difficulty, compared to 31% for the females).

Table 9
Calving Difficulty
(Miles City)

	Breed	
	Hereford	Angus
No.	95	103
Body Wt. (lb.)	833	792
Pelvic Area (sq. cm.)	247.	251
Birth Wt. (lb.)		
Male	73	69
Female	68.	67
Total Calving Diff. (%)	44	50
Calving Diff.		
Male	65**	
Female	31	

**P<.01

The calving difficulty was coded from 1 to 4, with 1 being no difficulty and 4 being extreme difficulty (either extreme pulling traction needed or a caesarean). Abnormality presentations were not included. If we look at the relationships between calving difficulty and pelvic area, and sex of calf and birth weight for the Hereford breed, the correlation between pelvic area and calving difficulty approached a -.18, a significance of less than 10%. There was a highly significant negative correlation depending on the way it was coded between sex of calf and calving difficulty, and a highly significant positive correlation between birth weight and calving difficulty for both breeds. As we look at the relative importance of these three variables, by looking at the standard partial regression coefficients or the path coefficients, we notice that pelvic area and sex of calf are approximately equal. Birth weight is extremely important or the most important as far as factors affecting calving difficulty in the Herefords. In the Angus highly significant negative association or regression coefficients were found between pelvic area and calving difficulty. Slight sex differences were found here. This was not significant, but again birth weight was the most important. One of the things that we need to consider is predicting birth weights of calves in terms of sire selection. This is an extremely important field.

Table 10
Calving Difficulty
(Miles City)
Relationships

	Breed			
	Hereford		Angus	
	r	b ^c	r	b ^c
Calving Diff. And:				
Pelvic Area	-.18 ^a	-.24*	-.22*	-.36**
Sex	-.47**	-.26**	-.26**	-.13
Birth Wt.	0.54**	0.48**	0.48**	0.56**

^a P<.10

* P<.05

** P<.01

We have many more studies that we have been going into but one of the things that might be most interesting is that of our work in trying to produce multiple births. Mr. Anderson, the physiology research assistant, is going to cover this for you.

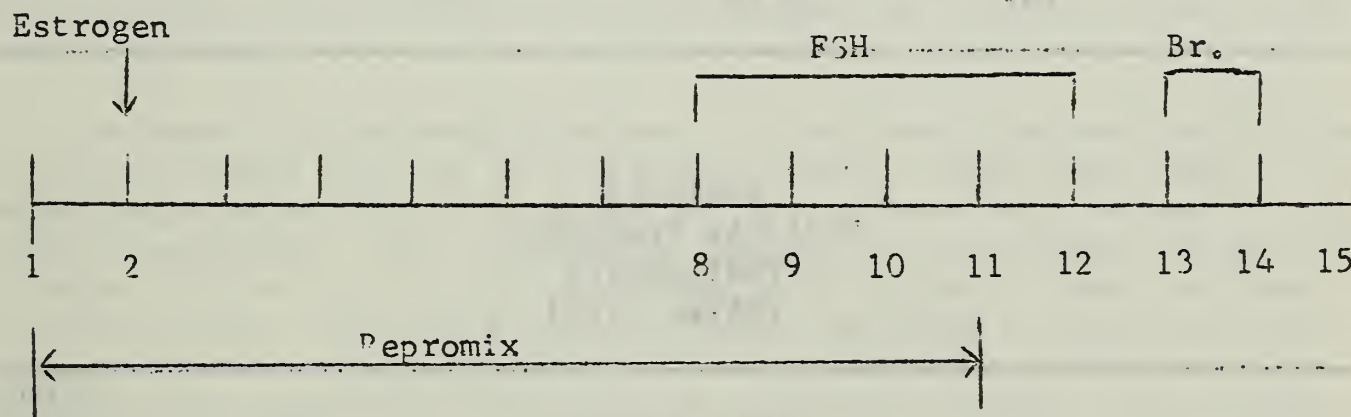
Mr. Anderson:

Since probably about 1962 Dr. Bellows has been doing work on multiple births here at the station, I was fortunate to get in on some of the work starting in 1966. I will just briefly summarize where we are at the present time as far as the multiple birth setup is. There is a paper being published now with this information in more detail as to the type of dosage ration that we have come up with.

I will just briefly run through some of the procedures that we are using now and where we stand. What we are doing is using FSH as the genetic hormone. We have been doing some work with the MS, but we have had better luck with the FSH. We are synchronizing our cycles so we have a known cycle on these animals. Before injecting the FSH we put some animals under observation to determine when their cycle is to start. We eliminated animals that have been in or that are in heat the first three days and those at the tail end of the cycle. Starting on Day Four we put them on their cycle and start synchronizing. We put them on repromix on Day One of their synchronized cycle; then on Day Two we come in with estrogen injected to aid in producing corpus luteum; then they are fed repromix for eleven days. Starting on Day Eight of the synchronized cycle we inject FSH. The best dosage was approximately found by injecting FSH twice a day. This was injected for five days (Day Eight through Day Twelve for a

total of ten injections). They were working out quite nicely by Day Thirteen. A majority were in heat on Day Fourteen, but probably 90% of the cows came in heat on Day Thirteen. The rest were definitely in heat on Day Fourteen. I will show some slides on our operation procedure to determine our doses of response. Three days after these animals were bred, they were all operated on and the oviducts were removed to determine the number of eggs and the fertilization rate up to that date. Some highly stimulated ovaries were obtained in some of the original work. We found a high degree of response to a small amount of FSH doing it this way.

Table 11
Treatment Procedure
(Miles City)



The important thing here that we are interested in is the number of two's and three's in ovulations. As we look at this, we see in the 3 milligram group that 12% of the animals had 2 ovulations. As we look at the 6 milligram group, 25% had 2 ovulations and 25% had 3 ovulations. As we go to 12 milligrams, we start seeing more variations 12% had 2 ovulations and 12% had 3 ovulations. If we go up into the 25 milligram group, we do not have any animals that have 2 or 3 ovulations. The group of heifers were injected with what we determined would be the most desirable level of FSH which was the 6 milligram level.

A study was set up with 10 control animals and 44 treated animals impregnated with the desirable dose of 6 milligrams. As we look at the pregnancy status, the control group had 70% in the first service, 66% in the second service with a total of 90% and 9 ovulations. In the treated animals 52% of the 44 settled on first service on a non-return basis and 81% settled on the second service. We have a total pregnancy status of 82% and 45 ovulations in the original 44 cows we started out with, for a 102% projected calf crop.

Table 12
Superovulation Summary
(Miles City)

FSH (mg.)	No. ova		Ovulations		
	Avg.	Range	Multiple %	2 %	3 %
0	1.0	-	0	0	0
3	1.1	1-2	12	12	0
6	2.1	1-4	62	25	25
12	7.9	2-14	100	12	12
25	14.6	1-32	86	0	0

Table 13
Multiple Pregnancy
Preliminary
(Miles City)

Group	No.	Preg. status			No. ovula- tions	Poten- tial calf crop %
		1 Serv. %	2 Serv. %	Tot. %		
Control	10	70	66	90	9	90
Treated	44	52	81	82	45	102

Dr. Bellows:

We have data that indicates that something has a very marked effect on return to estrus and pregnancy rate. Dr. Short is the project leader on some extremely interesting studies on the effect of suckling on the postpartum interval and conception rate.

Dr. Short:

I would like to go over some of the work that we are doing on the effect of suckling on the postpartum interval. On the interval from parturition to the first estrus of beef cows it has been known for several years that suckling does effect various reproductive phenomena. One of the main things that has been known at least in swine is that

this has a drastic effect on allowing the animal to come back in heat. This phenomena really hasn't been examined until recently in cows. In 1965 there was a report from Ohio State that suckling does have an influence on the length of time that it takes a cow to come back in heat. Subsequently Wisconsin has come up with some data that would indicate the same effect.

One thing about the earlier studies on the effect of suckling on the postpartum interval in beef cows is that the effect of nutrition was not always completely corrected. A cow which is not suckling a calf or not producing milk obviously does not require as much nutrient intake. I am sure that you are aware that nutrient intake will also have an effect on postpartum interval. So one might argue that cows which are not suckling a calf or are not producing milk will come in heat earlier because they are on a higher plane of nutrition. We ran an experiment last year in which we wanted to test this effect of suckling and correct for the nutrient intake on whether or not they were lactating.

We were also interested in why it takes cows that are not suckled a certain amount of time to come back in heat. From these past experiments we would expect a suckled cow to come back in heat in the 70-day postpartum, and a nonsuckled cow would take anywhere from 30 to 40 days. So why is it that this nonsuckled cow still does not come back into heat? You are all aware that a cow which is weaned from her calf immediately following parturition still has a certain amount of residual milk production and possible internal stimuli. So is there the possibility this residual milk production or internal stimuli has an effect on postpartum interval?

We had three groups of second calf Angus cows. In the first group there were 12 that were just normal suckled cows, in the second group the calves were removed from the cows and were not allowed to suckle, in the third group they were nonsuckled but they also had their udders removed approximately midway through gestation, which obviously terminated lactation.

We corrected the nutrient intake then as to whether or not they were in essence lactating, and fed these cows so that they would approximately maintain body weight. We weighed the cows immediately following parturition and then weighed them a week later or subsequently thereafter. We fed the suckled cows about 30 pounds of average quality alfalfa hay per day in order to maintain their post-calving body weight. In the two nonsuckled groups they were able to maintain body weight on only 18 pounds of average quality alfalfa hay.

The average interval to first estrus for suckled cows was 65 days which is what we could have expected from past experiments. The average interval for the nonsuckled intact cows was only 25 days so there was a significant effect on suckling for presence or absence of lactation even when nutrient intake was adequate. On the mastectomized cows the

average was 12 days following parturition, which was significantly shorter than for the suckled and nonsuckled cows. So we were able to shorten the postpartum interval further from the nonsuckled cows just by removing the mammary system. The cows were bred on their postpartum estrus and for every subsequent estrus if they didn't settle up to five services. The number of cows conceived in each group was 6 for suckled, 11 for nonsuckled, and 8 for mastectomized. The interesting thing on the fertility data is that the suckled cows averaged 1.7 services per conception, but it took the nonsuckled cows more services to get settled and their interval to conception was not much different than suckled cows even though they were coming into heat earlier. This was even shown further by the mastectomized group. They were coming into heat much earlier but they were requiring even more services per conception--an average of three services per conception. There wasn't any difference in the interval to conception for the nonsuckled group, and there wasn't much difference for the suckled group. We were able to confirm the effect of suckling and we were able to show that this interval can be further shortened by mastectomy, but we brought up another interesting problem in this study that even though these cows are coming into heat early postpartum, this is a very infertile heat cycle.

Table 14
Effect of Mastectomy and Suckling
on Bovine Postpartum Reproduction

	Suckled	Non-suckled	Mastectomized
No. cows	12	13	9
Lb. hay/day	30	18	18
Days to 1st estrus	65	25	12
No. cows conceiving	6	11	8
Services per conception	1.7	2.2	3.0

We are conducting some more work at this time on how and why this effect of suckling is coming about, and we are also running some studies trying to find out why this early postpartum heat is so infertile.

The procedure that we go through to mastectomize these cows may be of interest to some of you. These cows have to be put under a general anesthesia. The cows are brought into a holding chute, they are anesthetized and rolled out onto a cradle. The anesthesia that we are using is equi-thesis, this is an anesthesia that is used on cattle.

The cow is rolled out, the chute has paneling that can be taken out, the surgical area is clipped, and everything scrubbed up. We use plastic to keep away from the dirt. The complete mammary system is removed. An incision is made down the mid-point of the udder; you can peel the two main sections of the udder apart and then go underneath and seal off the main arteries to get away from most of the bleeding. Then an incision is made out along the teats on each side and the udder is skinned out and cut off. We tack some absorbent material to provide a place for the blood to clot, then the incision is sown up in a three cornered stitch. The cow is then none the worse off except she does not have milk producing ability.

Dr. Holland:

I would like to ask why, even though your number of services per conception was only 1.7, you only got 50% of your cows settled? Was there some reason why these other 6 cows didn't conceive?

Dr. Short:

All of those 12 cows were not bred, because some of those were having postpartum intervals out to 150 days.

Dr. Holland:

This services per conception was based on the number that conceived?

Dr. Short:

Right.

Dr. Cobb:

Were these cows on the grazing study mature cows?

Dr. Bellows:

No, there were some heifers in this--10-15% I would gather at the most. These were replacement heifers.

Dr. Holland:

Do you have a write-up I might get on this level of winter feeding in heifers?

Dr. Bellows:

We are right in the middle of getting it written up. I have a summary that is not for publication yet, but I can give you one of these.

Dr. Holland:

How long was the time they were on the spring pasture?

Dr. Bellows:

It averaged 6 weeks.

We had a puberty study on those replacement heifers. We took the heifers and put them in a calving difficulty study to see the effect of gestation and feed level on calving difficulty. We separated them into two groups. One group was on a low plane of nutrition during the last 90 days of gestation and the other group was on a high plane of nutrition during the last 90 days of gestation. The heifers on the low plane of nutrition gained .1 of a pound per day as compared to 1.1 pounds per day for the high plane of nutrition. They just finished calving last week so this isn't a complete set of figures. We increased birth weight of the calves by 4.5 pounds and had a 12% increase in calving difficulty.

Dr. Brinks:

On this cow weight in three different groups prior to the breeding season, did you get any cow weight means on these three different groups?

Dr. Bellows:

Essentially they didn't gain anything in any of these groups, they were fed to maintain body weight. The only thing that isn't true about that is that some of these cows in the suckled group had such a long postpartum that it was kind of ridiculous so we started pouring the feed to them.

Dr. Brinks:

I was wondering if those same kind of differences would hold up according to what you recommended in the level of gains for suckled cows? Whether they would gain on what you recommend for suckled cows?

Dr. Bellows:

I don't know.

Question:

Are these all dry lot cows in this study?

Dr. Bellows:

The suckled cows and nonsuckled cows were maintained in separate lots. This effect of suckling on milk production becomes quite

important. I think to the animal breeding men when they start selecting for milk production. What effect is this going to have on the ability of the cow to come back into heat? The dairy people have found that the level of milk production is highly correlated with postpartum interval. The more the cow produces the longer it takes her to come back in heat.

The more work we do on this, the narrower the limits we work within. If we go into the milk production selection end of it, we penalize ourselves in terms of postpartum interval and subsequent things of this kind. If we go in the direction of larger and larger animals, we penalize ourselves due to calving difficulty losses. So our limits become narrower and narrower. This is something that needs to be considered.

Dr. Butts:

How do we learn how much milk we need?

Dr. Bellows:

That is a good question, do we really need any?

Nevada:

Dr. Bailey:

In brief we continued our selection program this year with our five lines at two locations. In each case all selections were directed toward improvement in a single trait--either postweaning gain or postweaning feed conversion at Reno, or postweaning gain or postweaning efficiency at our new Knoll Creek Station.

Last summer I had the opportunity to spend some time with Dr. Harvey of Ohio State University, who helped us a great deal in our analyses; and we did accomplish a lot in the way of data analysis. One thing we did was to run an analysis on genetic trends in our beef cattle data. We are hoping now to add another year's data, and get a final analysis this summer. We did get a rather low coefficient determination on this first series of analyses that we ran, and this is one reason why we want to modify the analysis a little and add more data to it. Also we were able to get hold of Dr. Harvey's LSMLGP, Least Squares Maximum Likelihood General Purpose Program, and just this past week we have been converting the program to the Sigma Seven computer. We don't anticipate any difficulty in completing these analyses this summer, but we haven't reported the results since we will have these others forthcoming.

We have also done a little more in exploring the efficiency in beef production. This year as well as last year we have evaluated

bulls in our Reno lines on two levels of energy after they completed the postweaning tests. In addition we are completing the first of a series where we are slaughtering bulls at weaning time to determine initial body composition. Other groups are being treated with stilbestrol and others are not. Then they are slaughtered at 725 or 900 pounds to find out whether we can come up with a maximum combination of efficiency in terms of energy and carcass acceptability.

I also might add we now have a person on our staff trained in meats. This person, Dr. Ringkob, will be doing our quality evaluation work for this bull project.

One thing that we did was to complete the analysis in all of our rat work. We did get a rather clear picture in that selection was effective on a regular commercial laboratory diet during the postweaning period. This resulted in a higher heritability value for postweaning gain. These top gaining sires after six generations were progeny tested. Consistently their progeny grew more rapidly. We summarized a couple of those figures in this report. You will note that in the progeny evaluation the progeny of the regular diet sires were more efficient in feed conversion, in terms of gain to feed ratio adjusted for weight, gain adjusted for body weight, and for feed intake. There were no genetic differences in the body composition of these rats at the beginning or at the end of the test. I have concluded that selection was definitely more effective in a regular diet than on a restricted diet. Furthermore there was no evidence of a sire line by diet interaction in this data. There was some indication of some individual sire by diet interaction, but the over-all sire line by nutrition interaction definitely shows no indication of significance either biologically or physically.

This summer we hope to wind up our analysis of 15 years of postweaning selection in these lines for genetic analysis. Also to finish up the first three generations of this project, we are planning to progeny performance test all of our line bulls from all five lines along side those of the Beef Cattle Improvement Association bulls. We received some association money this year, and there are all sorts of potentials for this money. We would like to evaluate all of these bulls from all five lines along side the Association bulls, which will represent bulls throughout our state and then we would like to go ahead and progeny test 10 sires per line. Also we are going to make some rather drastic adjustments in our lines this year as to which bulls will be retained and which discarded.

Dr. Cobb:

You said you got a sire by diet interaction but you didn't get a sire by line by diet interaction?

Dr. Bailey:

This is true. There was some individual sire by diet interaction, but I don't think it is going to account for a very large portion of variation.

New Mexico:

Dr. Holland:

We have all the data that we are going to get on the inheritance of circulatory effects. At New Mexico we were concerned four years ago with the appearance of some ventricular septal effects in between the right and left ventricles that shouldn't be there in both lines of cattle. Also we picked up some patent ductus arteriosus in those lines of cattle. A project was set up to check the inheritance of these before we continued to make any use of these inbred lines. It is puzzling to me, but we haven't been able to produce any of these defects in deliberating setting out to try to produce them. From the results that we have, I would have to say that these are not simply inherited defects, so we have resumed selling cattle to breeders out of the Old Line. For about four years we shut off sales to private breeders because we were afraid it might be inherited.

During the year one Master Thesis was produced on studies of heritabilities, genetic and phenotypic correlations of noncarcass components, live and carcass traits. The noncarcass components were weight of the intestinal tract and components of the tract.

Our contributing project expires June 30 so we are not submitting any other project. We are carrying on the beef cattle breeding work with State money. The crosslines, which trace back to the bull that introduced the hydrocephalus cattle, are being used as a teaching herd and are being bred to outside bulls.

I have been given permission to transfer the Old Line from the Farm to the College Ranch. We are under pressure for land there at the College Farm because they are going to take the Interstate through the Farm. Right now we have 30 females from the Line on the Ranch. We have some more young females to go out and I have some calves by these 30 females on the Ranch this year. It would be hopeful that those of you in this Region and other regions that are going to have topcrossing experiments will use bulls from this Line because it would help me to justify keeping the Line. This Line has been evaluated somewhat at Mississippi and Arizona. A bull from the Line is doing quite well and is staying at the Bell Ranch right now. Mr. Ellis is making a tentative outcrossing in that herd.

The State breeding work principally will be the Brangus-Hereford crossbreed experiment on both the College Ranch and the Fort Stanton

Experiment Ranch. These are two quite different environments. I believe we have sufficient numbers on both ranches so this will be quite a meaningful project. I have been hopeful that this would be a W-1 project, if W-1 work continued. I am certainly thankful to Dr. Brinks who was the prime mover in getting me started on such a project, and to you Members of the Technical Committee who gave us a lot of helpful comments on the design of the experiment.

Oregon:

Dr. Bogart:

We have analyzed the data concerning growth and carcass characteristics of calves including organoleptic measurements, endocrine studies, and chemical studies of blood. We found both specific and general combining ability effects, but mainly these were in the post-weaning rather than in the preweaning stages. We attributed this primarily to the fact that our cows were rather poor milkers and that the calves did not have the environment that permitted them to express any heterotic effects prior to weaning. The greatest effect that we found with our linecross calves was in the reduction of mortality. Where the inbred cows were producing both linecross and inbred calves, there was 13.8% or 14% mortality in inbred calves and about 5% in the linecross calves. This indicates to me that there are all three types of genetics involved. They call it the simple gene or Mendelian type, epistatic or overdominance effects, and the additive or heritable effects.

We have continued our Angus line and have continued to make improvements in that line. In spite of the fact that it was a two-sire line with 22 head of cows in it, you see no evidence of inbreeding depression.

We have done quite a little work of what I might call a pilot nature using mice. One of these studies dealt with the selection of mice under 25, 50 and 100 r x-irradiation, with the idea of seeing if the greater amount of mutations that we could create with the radiation, might give us more genetic heritability from this previous group selection. We did find quite a bit of incidence of greater genetic variability; but we made less progress because fertility became a problem. Fertility seemed to be almost entirely limited to the females. Either the testes were not damaged to the extent that the ovaries were or they had the capacity to repair themselves whereas the ovaries did not.

We also conceived the idea of a selection method which would capitalize on two things. One would be maintaining a certain amount of genetic variation, and the other would be reaching for the very maximum in a particular trait. In the elite selection if you have three traits, select a third of your replacements entirely on Trait 1, a third entirely on Trait 2, and a third entirely on Trait 3, and then compare it with the index. We had six generations of mice in

this elite selection. We found that we did maintain a considerable amount of genetic variation by this method of selecting, but at the same time we held onto enough undesirable genes probably of the epistatic nature that our progress from our selection was no greater in the elite than it was in the index line even though we had greater genetic variability. Supposedly during the later generations we should have made more progress.

We have completed the work on some of the liver coenzyme studies and have submitted a publication on this.

I might say at the present time we are in the stage of formulating two larger lines. I guess I would call them synthetic lines. One is going to be based on combining our three linecrosses 1 x 2, 1 x 3 and 2 x 3 male and females into a population; and the other will be using females of our linecrosses 1 x 2, 1 x 3, and 2 x 3 with the Miles City 1 x 4, 1 x 10 and 4 x 10 linecrosses. We have calves produced by making these linecross combinations. We have some real good heifers and bulls as replacements among these young animals we have produced in both groups so it looks encouraging. We also have the data all gathered and are ready for the analysis on measuring the female productivity of our inbred and linecross cows in regard to specific general combining ability and reciprocal effects.

Dr. O'Mary:

Did you have any problem maintaining the line?

Dr. Bogart:

At the initial stage I ran into some real problems because I got two years in a row where only two heifers were produced in the line; therefore, my cows just got older by two years. After that, the sex ratio balanced out and I haven't had any problem.

Mr. Urick:

Did you have any comparisons that were positive from the linecross bulls versus inbred bulls?

Dr. Bogart:

The only observation I have is just a general observation in linecross bulls. The linecross bulls certainly seem to show more vigor than the inbred bulls.

Utah:

Dr. Madsen:

I am here representing Dr. Bennett. He hopes to get here tomorrow sometime. He is attending a Charolais sale and is hoping to pick up some animals to add to the herd.

They are now working on the objectives called for in the revised project. We presently have the two breeds, Hereford and Charolais, that are called for in the project outline. Since this is the first year under the revised project, the number of cattle are relatively small particularly the Charolais. We are adding to that group as rapidly as possible.

The primary objective of the project at this stage is to measure the feed efficiency of the two breeds. At the present time the calves are being weaned at a relatively young age at possibly 3 1/2 months of age. They are then put on individual feed trials, and are to be slaughtered at approximately 900 pounds. The first animal was slaughtered last week. At the present time we have eleven Herefords on test, three Charolais-Shorthorn crosses, and two Charolais calves. This is a relatively small number to start with. We hope that we finally will be able to accumulate sufficient numbers over the years to make it meaningful. We also plan to measure feed efficiency of mature animals as well. Dr. Bennett is not sure that it is going to show much difference, but at the present time he feels that this phase should be investigated. The evidence indicates at the present time that Herefords have a slight advantage for gain per pound of feed. Crossbreeds are intermediate, with the Charolais being ranked the lowest at this time. It is the opinion, however, that the Charolais they are working with are not the best type. They are attempting to get some new stocks to add to this.

They have made one analysis on the effect of inbreeding upon the birth weights and rate of gain of suckling Shorthorn calves. At the present time we do not find any effect of inbreeding on these two traits. In other words the inbreeding has not suppressed the birth weight or the suckling rate of gain. If we analyze this in more detail, it appears that this mild rate of inbreeding was accomplished, though actually many individuals have very high coefficients of inbreeding up to approximately 30%. Perhaps the answer here is that we did have fairly intensive selection for mature size and gain on these and this has offset the effects of inbreeding. We are going to make more detailed studies on this particular feature.

Dr. O'Mary:

Do you have any statements from cattlemen in your state in regard to the dispersal of your Shorthorns?

Dr. Madsen:

No, not a great deal of comment on it. In the first place there were only two or three purebred breeders of Shorthorns in the State, and they are more or less pulling out of it themselves as far as registration is concerned, so we did not receive much comment on it. We had more questions raised by people in the professional field because they hoped to maintain the lines available in the State, but not much from commercial or purebred breeders.

Washington:

Dr. O'Mary:

At Washington State University we still have the three herd sires that we have been using up until this last year. We had a significant problem with quite a lot of inbreeding in one of our bulls, so we eliminated this bull and his sons from the project and concentrated on the Angus-Eileenmeer breeding. We are still keeping the two groups of twenty cows each in the closed line. The inbreeding is going to increase faster than I had hoped because of the elimination of that real poor performing sire that we were using. This spring we acquired a new herd sire to go into Group C. This was the design of the experiment to try to pick up a new bull for this group from an outside source. We did locate one that was performance tested for this particular group.

As far as results are concerned, we have practically nothing to report this year. We have had one graduate student that started on this work. He is interested in studying some of the effects of these variables which I mentioned in the report (age of dam, weight at the beginning of feed test, final test weight, age at beginning of test, and average daily gain) in order to determine the relationship of some of these variables to feed efficiency. We are still using the facilities for individual feeding of both bulls and heifers. The facilities will accommodate 55 head. We hope then that we will be able to get more information on feed efficiency. We are still using the same kind of rations that we used for 10 years. We still have a little problem of bloat as we have had all along. Usually we lose one or two animals on this test.

The other thing that we have done this year is to try to work to get a cooperative effort within the State. We do not have State Associations as some of the states have. We have six cooperators lined up for cooperative studies, more or less using their herds along with Washington State University's herd as guidelines.

We have all of our data on cards now. We are trying to summarize it by using these 10 years of data and by trying to figure out some of the variables and what emphasis we want to place on each one.

The problem that some of you are probably facing is continued encroachment of other segments of the University on the College Farm. We are somewhat short on pasture. We are moving our Shorthorn herd to the Cross Ranch which alleviates the situation just a little but not very much.

We do have our numbers up to the limit of our facilities in every way that we can possibly stretch them. We still have the 60 head of Angus cows and are keeping around 20 head of replacement heifers until they produce their first calve.

Wyoming:

Dr. Nelms:

We have recently completed a study on the effects of inbreeding on the weights of cows. It would appear that the effect of inbreeding does carry on through to the older cows' weights.

We analyzed carcass cutout data on about 180 head of bulls and computed a fairly good prediction equation for bull carcasses. We can now evaluate the animals without having to go to the trouble to cut them up completely to get this data.

P R O J E C T R E V I S I O N

PROJECT REVISION

Oregon: (Rev. #3)

Title: Selection and inbreeding effects and associated changes in gene frequency in synthetic lines of beef cattle.

Personnel: Ralph Bogart, Project Leader, and Graduate Assistants, Oregon State University, Corvallis, Oregon.

Duration: 8 years.

Objective: 1. Assess the genetic changes in two synthetic lines (one resulting from combining three inbred lines and the other from combining six inbred lines) resulting from selection and inbreeding by use of polymorphic traits. 2. Determine the comparative improvement that can be made by selection in two synthetic lines that differ in width of genetic base. 3. Compare two synthetic lines differing in width of genetic base for inbreeding depression. 4. Attempt to identify animals of outstanding performance by chemical constituents of the blood and enzymatic activity of the liver and blood.

Justification: Several inbred lines of beef cattle have been developed. The small one-sire lines have shown inbreeding depression; whereas lines with a wide genetic base in which several sires are used have not shown inbreeding depression. Synthetic lines in plants developed from a base resulting from combining inbred lines have proven to be much superior to the original lines. It appears that synthetic lines of beef cattle might be the most effective method of maintaining breeding material which has the capacity to transmit with a high degree of regularity. It is of utmost importance that performance in closed populations be maintained at a level that can support the populations. It will be valuable to see what improvement can be made in 2- to 3-sire synthetic lines by selection and to compare synthetic lines that differ in width of genetic base.

Recent studies with polymorphic genes have provided a basis for evaluating the effects of selection and breeding systems on homozygosity that is produced or prevented by selection. A great deal can be learned through studies of hemoglobin types or transferrin alleles about changes that are occurring in the genetic composition of the populations as selection and inbreeding are being practiced.

One important aspect of a breeding program in which closed populations are used is need for a wide genetic base. A comparison of two synthetic lines, one resulting from combining three inbred lines and the other from combining six inbred lines, should provide information on the value of width of genetic base for making progress by selection and for overcoming the depressing effects of inbreeding.

Plan of Work: Two synthetic lines of Herefords of 30 females and 2-3 sires each will be developed. One synthetic line will be developed by combining Oregon State 1 x 2, 1 x 3 and 2 x 3 linecrosses. The other synthetic line will be developed by combining Oregon State 1 x 2, 1 x 3 and 2 x 3 females with U.S. Range Livestock Station 1 x 4, 1 x 10 and 4 x 10 males. U.S. Range Livestock lines 1, 4 and 10 have proven to have high performance and to have strong combining tendencies as demonstrated by studies made at San Carlos, Arizona. The Angus line of 2-22 females and two sires will be continued.

Selection will be based on six traits: Fertility, suckling gains, feed-test gains, feed efficiency, live animal score for carcass merit, and freedom from inherited defects. Fertility and defects will be selected on a minimum culling level basis by eliminating males and females that are defective. The other four traits will be combined into an index with equal emphasis given to each trait.

Feed testing will be conducted from 450-800 lb. for bulls and 400-750 lb. for females. A test ration composed of 1 part alfalfa hay: 1 part grass hay: 1 part of concentrate mixture in a one-inch pellet will be used. This ration has been shown to have 65% digestibility and contains 14% protein. Results from feeding the ration have been successful.

Complete production records will be obtained such as date and weight at birth, weights at 2-week intervals, and feed consumed. All males will be intact until the end of the test and all males and females will be feed tested.

Chemical constituents such as amino acid and urea nitrogen levels of the blood will be obtained at the beginning and end of the test. The transferrins and hemoglobin types will be determined on each calf to ascertain the increase in homozygosity resulting from inbreeding and to see if a particular allele is being increased in frequency as a result of selection for production traits. If personnel are available, liver biopsies will be obtained when the feed tests are completed for determining liver nicotinamide dinucleotide coenzyme activity. Research at Oregon State has shown that these coenzymes are related to rate of gain, and fat-lean composition of the carcass.

In order to evaluate yearly variations repeat matings will be made. The plan is to use three bulls each mated to 10 cows in each synthetic line the first year. The bull with the best record of the three will be retained for the second year and mated to the same 10 cows. For the third year, two young bulls will each be mated to 10 cows and the bull with the best record of the two used in year two will be mated to the same 10 cows to which he was mated the previous year. This process will be continued. It essentially develops that each year two good young bulls are kept and used and one older bull is used for repeat matings. This gives a heavier selection pressure for the bull with the best record. It allows for 10 repeat matings

each year in each line which should be sufficient because one can use the repeat matings of both lines for evaluating yearly differences for each of the synthetic lines.

Cows will be culled heavily so that young females can be added to the herd as a means of turning over generations as rapidly as possible. The use of two yearling and one two-year old bulls each year provides for rapid generation turn-over also.

The repeat matings will be useful in the physiological studies (hemoglobin and transferrin types and the blood chemical constituents) as well as in evaluating yearly variations in performance data. This will be particularly valuable when one relates the physiological information to the performance data.

At the end of eight years (2 generations) data will be analyzed to determine:

1. Phenotypic progress made by selection in each of the three lines.
2. Genetic, phenotypic and environmental variation in the populations (Three lines).
3. Change in amount of homozygosity in each of the lines as measured by polymorphic genes.
4. Genetic and phenotypic correlations among the performance and physiological traits.
5. Changes occurring in heritability estimates over the 8-year period.

T E R M I N A T I O N C O M M E N T S

TERMINATION COMMENTS

COMMENTS OF CHAIRMAN

Dr. Blackwell:

This is a tremendously important meeting to W-1 and the future of beef cattle breeding research, and we want to take the maximum amount of time available to us to discuss the future of this committee and the future of beef cattle breeding in the Western Region.

I will review some of the information that came to me on the termination of W-1. I believe I have kept you informed as I have been informed on developments.

Before I go further into that, I would like to say that Mr. Knapp, Dr. Brinks, and Dr. Nelms did an excellent job of getting together the ten-year review and the material that the Directors wanted for their February meeting.

I sent a note to you people early in the fall about the ten-year review and the possibility that the Directors were going to talk about termination or revision. I received this letter from Dr. Meyer dated December 18, 1968:

"Enclosed is a resolution from the Western Directors concerning A Substitute Recommendation for W-1.

"You will note that it is basically the same as that sent to you on September 27, with the exception that it clearly states that they plan to have their Spring meeting to decide on the termination or revision of W-1.

"Basically, I believe that the Western Directors feel some hesitancy about a regional project extending for such a great length of time. Some members have the feeling that in the future there should be quite a different approach in this general area."

The enclosure letter with that letter was a copy of a letter to Dr. Meyer from Dr. Linsley, Secretary Western Association of Agricultural Experiment Directors:

"At the fall meeting of Western Directors, the Regional Research Committee recommended, and the Western Directors, accepted, the following statement:

"A Substitute Recommendation for W-1, 'The Improvement of Beef Cattle through the Application of Breeding Methods.'

"It is suggested that the statement concerning the W-1 regional project that appeared in the July 1968 Minutes of Western Directors be clarified by the following action taken by the Western Directors at the fall 1968 meeting:

"The Western Directors request that the W-1 project be revised or terminated as of June 30, 1970. If the W-1 committee feels that termination is not desired they shall prepare, for the Western Directors' spring 1969 meeting, a summary of ten-years' accomplishments with special reference to attainment of current objectives and a syllabus containing justification and objectives of a proposed project revision. The Western Directors will consider this syllabus at their spring 1969 meeting and ask for either a June 30, 1970 termination of W-1 or instruct the W-1 technical committee to prepare a revised project outline for further consideration by Western Directors at their spring 1970 meeting."

I received a copy of a letter that Dr. Meyer wrote to the Western Directors Regional Research Committee dated February 4, 1969:

"Enclosed please find the comprehensive review of W-1 prepared at the request of the Western Directors.

"The concise discussion of accomplishments indicates a fairly productive project.

"Work needing further investigation, as described, is broad and in many respects is similar to the recent program because of the long term nature of beef cattle breeding research.

"Future Regional projects in beef cattle breeding need careful consideration because results from experiments initiated at this time will not be available until in the late 1970's when population pressure may have a severe effect on world food supplies and land resources. Hence, a bold and imaginative project is needed. Success with plant breeding in achieving large increases in productivity and product quality suggests that it is possible biologically to make greater strides with animals than in the past. This suggests a departure from past programs. On the other hand, an abrupt departure from on-going research is not economical because of use of present academic personnel and facilities.

"Areas of studies suggested by the Technical Committee may be too broad and far-ranging for Regional Research.

"One alternative is to suggest two Regional beef breeding projects to take advantage of on-going research and to emphasize and focus on other ideas. One project would be to continue W-1 focused on

- Area 1: To develop and evaluate selection methods and breeding systems which will be effective in improving economically important characteristics of beef cattle.
- Area 2: To study individual genes, inbreeding, and linecrossing and their effects on the many traits in beef cattle.
- Area 4: To determine the relative importance of genetic-environmental interactions by studying the response of inbred lines of beef cattle under different environmental conditions.

"The second project would be focused on

- Area 3: To evaluate the effectiveness of crossbreeding and selection procedure in heterosis studies on the various economic traits of the various breeds.
- Area 5: To determine the mode of inheritance of various deleterious and beneficial mutant characteristics in beef cattle.
- Area 6: To introduce and test new or derived breeds or types of beef cattle.

which would widen the gene pool and increase long range possibilities for major advances in beef cattle breeding, especially in heterosis. Industry has shown real interest in this approach and we need to give leadership.

"Area 7 should be part of any good breeding project and need not receive specific attention.

"The second alternative is to continue W-1 as outlined by the Committee.

"I suggest the first alternative because it provides more definitive focus for each of two projects and allows an emphasis in a new area not heretofore highlighted."

I talked with Dr. Meyer on the phone and then I sent you a note saying that W-1 is to expire June 30, 1970. An interpretation of the Western Directors' thinking may be that there are too many regional projects, and they may want to give more effective support to a fewer number. They may be thinking of a multiple-disciplinary approach to beef cattle research. There is to be a task force on beef cattle research which will come up with a report for the Western Directors.

COMMENTS OF ACTING ADMINISTRATIVE ADVISER

Dr. Burris:

At the fall meeting of the Western Directors there was an ad hoc committee designated to look into the problems of regional research in the Western Region. One of the problems that the Regional Research Committee has is determining the priority of a regional project over others. The real problem is the basis to use in deciding which project will be supported. The task of the ad hoc committee was to look over the problem and see if perhaps there wasn't some better way of making a decision on what we should be doing in regional research. They came back with the recommendation that a number of task forces be set up corresponding to the National Task Forces and that five or six of these be established immediately on an experimental basis. Their purpose is to identify the problems of research which can be answered through a regional approach. It happened that there were at least two beef cattle projects which were scheduled for some termination or revision as of July 1, 1970. There were some eight or ten projects that were also scheduled for termination or revision on the same date. The ad hoc committee designated six areas, and the last one to get on the list was beef cattle. So the six task forces were set up and I was asked to be administrative adviser to the one task force on beef cattle.

The stipulations of these task forces have already been mentioned. One was the need for an interdisciplinary approach to the problem. I think really what the Directors had in mind was not so much an interdisciplinary emphasis on the particular problem but how do you bring all we need to know about beef cattle into some kind of a pattern so it answers questions of the livestock producers on a total basis. The problem is that one segment is way ahead while other segments are really lagging behind and are crucial. At the July meeting the task force reports from these six groups will be sent to the Directors. The Western Directors will go over the task force reports to see if this is a valid way to approach the problems, both in structuring and obtaining better cooperation in the research so that it is doing a better job of answering the needs.

The members of the task force committee are: Dr. Blackwell, head of the Animal Science Department at Montana State University and chairman of the W-1 Committee; Dr. Hawkins, head of the Veterinarian Department at Montana State University; Dr. Bellows, a Physiologist at the U. S. Range Livestock Experiment Station, Dr. Hale, a Nutritionist at the University of Arizona and a Committee Member of the National Task Force on beef cattle; Dr. Logan, an Economist at the University of California; Dr. Youde, Assistant Professor in the Agriculture Economics Department at Oregon State University; Dr. Rubin, a Parasitologist at Colorado State University; a man from Dillon, Montana, who had been on the Research Committee of the American Cattlemen Association; and two or three others. We tried to get a cross section of people chosen for their interests, their professional competence, and their ability to put "input" into a problem of this nature. We also tried to get some representation on a geographic basis.

The different members of the task force were asked to prepare statements on four different areas that the committee felt was important to beef cattle. One of these was improved management systems. This includes breeding work, crossbreeding work, economics, and accommodations of resources. The second category was in the area of reproductive performance and included physiological problems, pathological problems, nutritional problems, and all related problems to reproductive performance. The third area was the problems of marketing beef which included retailing and packaging. The fourth area was related to location and transportation problems, which included location of production areas, location of feedlot areas, and slaughter facilities relative to the land, feed, and labor.

We also made recommendations to other task forces regarding feedlot pollution and waste disposal. There is a pollution task force. Relative to multiple land use in beef cattle there is a forestry task force. Relative to beef and human nutrition (particularly health hazards) there is the human nutrition task force. These other task forces are the six that have been set up with the suggestion that these should be included in the areas that they are recommending for regional research.

I am waiting patiently till May 15 to get back reports from the four subcommittees of this task force on what would be included in the first four categories I mentioned. At that time I will try to put these together in a total task force report which will go to the Western Directors by July 1 according to instructions. Dr. Sierk has met with us and is a member of the committee from C.S.R.S.

This is the general background of this task force. It is my interpretation of the Directors' action at their February meeting that they handled W-1 a little separately from the other projects that were put on the shelf until after the July meeting. I believe my interpretation is that as of July 1, 1970, there won't be a W-1. We may have regional breeding research and this sort of thing, but I don't believe the opportunity for extending W-1 as it is at the present time is one of the options we have. Their actions have indicated of the two alternatives they had of extending it were either revise or die. The die part is not quite what was chosen, but it kind of amounts to that as far as what we have always known as W-1.

I think that the Western Directors felt that the ten-year summary that was presented was an excellent presentation, and that it indicated a great deal of accomplishment in W-1. I believe they thought there was a real need for restructuring. I do think there is a high regard of the Western Directors for what W-1 has accomplished in the last 21-22 years. I don't know to what extent the leadership we have in this committee will play in what evolves, particularly in this category of improved management systems in beef cattle. It won't be restricted to this current committee; I believe there will be people on this committee that probably will not take a major part in the new organization.

On the other hand, they may decide this is not a very good approach to use and completely swamp the whole thing and suggest that projects be developed perhaps in the more conventional areas as we know them.

Dr. Brinks:

Under your four headings where would such things as body composition and genetics fit?

Dr. Burris:

I expect our subcommittee will develop something that will include these categories. I don't think we will end up with everything that we are doing that should be regional research. There are a lot of things that we can accomplish as individual efforts. In just listening to the reports this morning, just to be frank with you, I think on a lot of these things it wouldn't make much difference whether we got together once a year to do them or whether we operated on our own. Admittedly, we get a lot of good counsel on things like this, but does this really make a difference in what we do? I would say in some cases it does, I think in the work that Dr. Roubicek has down in Arizona it is almost essential to have a regional project to really accomplish this thing. I think you can pick out several cases where this is in effect essential. I don't think you can say where would this fit, where would that fit, because a lot of the things may not fit at all and maybe how they fit is dependent on what group gets together to formulate a regional project under the new system.

Dr. Bogart:

It seems all the way along in W-1 we have been criticized as trying to cover too wide a territory. Now we come along with the Directors trying to bring nutrition, physiology, genetics, parasitology, disease, economics, marketing, everything into a task force. I can't see that it would be of interest for a bunch of us to get together and have some report on transportation, some on economics, and some on the life cycle of some parasite. I am sure if I reported something on genetics, this marketing specialist would say, "Well so what." I was wondering about the thinking of the Directors.

Dr. Burris:

I would say that the idea is to get something that is a functional program within the regional project. Supposedly as near as I can tell out of this thing would come something that would be an integrated answer to some of the problems such as beef cattle production. In reply to this question on broadness, I think part of the problem is that one person will go quite a ways in physiology, genetics, and things like this, and he is almost operating on his own relative to

what the rest of the committee is doing. In a sense this is broadness, and I think it is good, but is it a committee effort or an individual effort?

Dr. Bogart:

What will be the case in this task force? Won't they all be doing individual efforts? I can't see how you are going to have a task force working as a cooperative integrated unit.

Dr. Blackwell:

The task force as I understand it will not organize the technical committee; they will not supervise the research that is done. They will make recommendations to the Western Directors as to areas of research and possible suggestions of ways of improving regional research. I think this is the principle task of the task force. I will quote from the instructions to the administrative advisers of the six tentative task forces:

"The charge of the task force committee is to:

- A. Involve themselves with the multiple discipline emphasis.
- B. Restrict themselves to areas covered by the counterpart of the National Task Force reports.
- C. Consider and make recommendations on matters appropriate to the Western Region."

Dr. Bailey:

How would this be implemented? Would they call for submission of proposals and then endorse these or put them in on merit or how would this be?

Dr. Burris:

My thinking is that we as a task force will indicate these four areas that I have mentioned as areas in which we feel there should be regional research initiated. We will have priorities in these four areas, and this will be the recommendations to the Western Directors. The Western Directors will take these four areas of beef cattle problems, and a similar number from some of the other areas, and they will decide at that time what areas are to be pursued since there can be financial support for only a certain number of these. Then they will ask for an administrative adviser to set up technical committees to formulate regional projects in these areas.

COMMENTS OF COOPERATIVE STATE RESEARCH SERVICE REPRESENTATIVE

Dr. Sierk:

You should keep in mind that it is not the intention of anyone that I know of to leave the impression that beef cattle production is not important. Also it should be recognized that there will be support for beef cattle production particularly in the Western Region and in other areas.

The record is clear as to what organized or unorganized beef cattle production research has done for industry. Industry has adopted many of the results from research. There is plenty of evidence to indicate that there has been a payoff and perhaps that certainly there can be more. All of the information that you people have developed is not being applied, that is true, but this is not peculiar to beef cattle production, it is across the board in all kinds of research. It has been difficult sometimes in the past to come up with this in a dollar figure. What is going to be the payoff as you look ahead on the research that you do? It has to be understood that there are limited funds available for research both at the state and federal level. What and where is the best place to put these funds? The people that are asking these questions are the ones that make these funds available--primarily the appropriation committees in the U. S. Congress and appropriation committees in your own state legislatures. Unfortunately, I suppose speaking now as we are here with a commodity, beef cattle, these legislation groups get some pressure from other commodity groups and socially oriented groups for these funds.

You may or may not have heard of P.P.B. (Programing, Planning, and Budgeting). It has been with us for a couple of years and just within the last couple of weeks the current administration, after having reviewed this system, said that this would continue for at least another year as a means of developing the budget for fiscal year 1971. Fiscal year 1970 appropriations are beyond our influence at this time.

The various agencies have given their pitch to the subcommittees on appropriations before the National Congress. The 1970 fiscal year budget is now in the hands of the Congress. Since Congress has not acted upon the appropriations, the funds for the fiscal year are not known at this time. Therefore most department heads, experiment station directors, branch chiefs, or agencies in the Federal Government are thinking of developing their planned programs based on about what funds were available this past year. The appropriation figures do indicate that there will be some increases. These increases over the current year would be about equal to the cost of living adjustments. What Congress does finally appropriate will be something else. In other words the likelihood of funds being available for additional programs is not very great. This is what faces the various people who make the final decision on where the money is going to be used.

This past week the Committee of Nine on Regional Research requested the Directors to indicate what their allocations would be for fiscal 1970. It has already been indicated that W-1 would continue in its present form through the next fiscal year.

At the present time we are working with a national program of research for agriculture as a broad guiding document that was jointly developed by the state and the federal agencies. The document indicates the type of research needed and the amount of funds needed for the next ten years. As capable as most of us feel we are, to project for ten years is assuming quite a bit. So let's not be too concerned that there will need to be adjustments in this as we go along. This is recognized and has been recognized, that this is not a completely shut situation.

Dr. Roubicek:

From your office as you see the overall picture how do you feel that you can rank the importance of group meetings such as we have here--of technical committees within specific areas? In other words for many of us this is the most important part of regional research. The fact that we do get together and discuss problems is really what is important. Would there be any possibility to think of regional research funds as actually supporting a multitude of technical committees rather than putting the money into research? This is one of the things that we are afraid we are going to lose--our continuity.

Dr. Sierk:

The Directors are quite aware of this, Dr. Roubicek, there is a plan whereby this can be done.

Dr. Burris:

This is really a second recommendation of the ad hoc committee which I mentioned earlier. There was to be established a number of regional coordinating committees whose only responsibility would be to get together and discuss things. There are a number of these committees that operate simply as high-powered discussion groups. I think everyone realizes the need for something like this. We just delayed action on this phase of the thing until we saw how the other approach would work out. I think there will be areas where this will be the main function. In other words they won't have regional research committees as we know them, but they will be just coordinating committees.

Dr. Sierk:

There is a precedent for this, other regions have done this particularly in the North Central Region where they have kept what they call North Central R committees. These are in effect groups on

particular subject matter, it may be narrow or it may be broad. The people that are concerned with a particular problem get together once a year to discuss what they are doing, where they are going, and do some joint planning even if it isn't on a formal basis. Section 3C3 of the Hatch Act sets up the regional research fund. The Committee of Nine makes recommendations on how these funds shall be expended on projects and these are approved by the Secretary of Agriculture. The only place in the Hatch appropriation that the word project appears is in the regional funds project. The law says up to 25% of the Hatch appropriation can be used for research in which two or more states are cooperating. Each of the four regions have an approved project in which regional funds can be allocated for these coordinating committees. The whole question is how much of the total regional fund can you put into such a project when the language of the law says that the R.R.F. (Regional Research Fund) shall be used for research.

Dr. Bogart:

You pointed out that the important thing is that it pays off in the future. What is the setup for trying to predict what is going to pay off in the future and how long in the future is this being looked into on a planned basis? I think there is quite a difference in how long it is going to take to get a pay-off in the different areas of work. I think people always tend to support short-term experiments instead of the long-term experiments. I also think that when we see an imbalance in certain things; we always tackle the experiments that are short-term before the ones that are long-term that need support. This usually lowers productivity, if anything, down to the lower level. I am wondering is this isn't a thing we want to watch in our thinking in this matter.

Dr. Sierk:

Yes, people are looking for answers to these various questions and when you decide to go into a piece of research, somebody has to justify the expenditure on it. You do this to an extent when you present this proposal to your Director.

Dr. Bogart:

But I don't see that reshuffling the ideas of approach will make it any easier on the Directors to reach a decision, because they are going to have these same decisions under the new approach.

Dr. Sierk:

I guess what we are saying is that you do the best job that you can in presenting your program to the Directors. The Bureau of the Budget has to make some sort of recommendation--so much for agriculture, so much for AEC, so much on down the line. Finally Congress takes a look at this and appropriates the money.

Dr. Putnam:

I would like to clarify one point in relation to Dr. Roubicek's question concerning this coordinating committee. I think if I understand your question correctly you are concerned specifically about the technical people having an opportunity to get together and communicate in a meeting such as this. Your answer could imply two things--continuation of this approach or a coordinating committee that was somewhat higher administratively.

Dr. Burris:

I think that the coordinating committee that we are talking about is on the scientist level basis, therefore, it would be a technical committee. There might be some question as to whether it would be a W-1 Committee or a committee that is perhaps a little more heterogeneous. There is a possibility that there might be a reduction of regional projects perhaps to some degree and establishment of these types of committees.

Dr. Bailey:

Would this committee be organized by disciplines or commodity groups? In talking to our Director I got the impression that this would be according to commodity groups. Would beef cattle include nutrition, physiology, economics, and this type of an approach, or would it be according to more existing lines, for example, having a breeding group and an animal nutrition group?

Dr. Burris:

I think there is no predetermined way that this is going to be set up, and I think there is justification for any sort of group to get together. I would say there is an indication that these regional projects should be on an interdisciplinary basis, but I do not think the same thing applied to the coordinating committee.

Dr. Bailey:

For example, would an economist in one state be on the committee, and a geneticist from a second state, and would they be dealing with a project actually in progress physically in a third state? Is this what we are talking about or exactly how would this program function?

Dr. Burris:

After this task force meeting, I raised about six questions. One relates to this, one relates to the one that Dr. Bogart had about how you get these committees together, and things like this. I just put these together and sent them back to the Regional Directors at large and said that these are some of the real problems that grew out of our task force meeting.

Dr. Brinks:

I have kind of mixed emotions I guess. I don't know whether to try to change the Directors' minds with a statement of some sort on revising the W-1 project or not. I don't think it is going to change much of the work in the states at least it will not in our program in Colorado. The thing that bothers me is that I don't know what the Directors are thinking. It seems to me that the Western Directors as a group are searching for these integrated answers that they don't have on their finger tips. As a way of getting these integrated answers, they are thinking of reshuffling or changing our technical committees as we now know them. It seems to me that integrated answers depend on technical information, and I don't know if they are going to solve their problems by getting these integrated committees. They certainly aren't going to be technical committees as we have known them in the past. Should we as a group send a statement to the Directors saying we would like a revised project? I don't think we really need a statement.

Dr. Bogart:

I think it would be real good if we would get an idea from the Directors on what we need to do to move forward.

Dr. Blackwell:

The task force report is to be used by the Stations to organize a project. Isn't this correct?

Dr. Burris:

Actually the report is to be used by the Directors. If the Directors pass on the report, then there will be certain information in the task force report which will perhaps be instructive to the technical committees.

Dr. Brinks:

What I can't see is why all of the sudden these people want all of these integrated answers when in the past they have been satisfied with a lot of good technical information from the technical committees. It seems to me that in the past this integration has been done by industry itself. I think in the future, industry is going to believe in integrating a lot faster and they will need more technical information. It seems like quite a shift in philosophy.

Dr. Bogart:

What will be the viewpoint of the Directors if they go along with this concept of task forces and no research personnel shows any particular interest in it?

Dr. Burris:

Frankly I think this concept is experimental. We will take these task forces to see if there is any way to get some of the answers that industry is asking.

Dr. Bailey:

Is beef cattle an appropriate species to experiment with in regard to an administrative procedure or should this be done with poultry, mice, or field crops?

Dr. Burris:

I don't think it is restricted to beef cattle. There are others. There are essentially five other task forces.

Dr. Bailey:

After the experiments are carried out with these other short-term programs, I wonder if they will be dropped or incorporated into programs in the state in beef cattle. You can't change things around very rapidly.

Dr. Burris:

I think there won't be a great deal of change in research actually done by people on this committee, but part of the problem is that you fellows have had a monopoly on most of the beef cattle regional research effort in the past 20 years. Can this charter go on forever? There is a philosophy that they need to reshuffle a committee so there will be some different concepts and different approaches to problems.

Dr. Brinks:

We need integrated answers, but on a regional level it is kind of hard. Even integrating on the state level in the department in the school of agriculture is hard. How many directors would integrate within their own school of agriculture and college?

Dr. Bogart:

In our University when you get people interested in nutrition, physiology, and production together, they don't seem to show much enthusiasm in working together or in discussing things. On the other hand when you get all the people from a discipline together regardless of species, they really work things over. I think it is going to be almost impossible to get this big wide concept of an integrated program and have everyone interested in working with everyone else.

Dr. Burris:

One point it seems to me that we have neglected is interdisciplinary in nature. We get a lot of answers to problems that are pure genetics, pure physiology, and pure nutrition; but when it comes to genetic implications of nutrition and nutritional effects of physiology, it is more complex. These are the problems that seem to be the most difficult to answer.

Dr. Bailey:

Shouldn't this be done in the department of a particular institution rather than on a regional basis?

Dr. Burris:

This is my point that it is not being done.

Dr. Bailey:

If it is not being done there, I don't know if there is any hope for it being done on a regional basis either.

Dr. Burris:

This is the point, there may be some hope of some way of reorganizing these regional projects so it would make it convenient for these people to get together. Just like W-1 has made breeders get together.

Dr. Putnam:

Could this committee improve itself so it is palatable for the Directors?

Dr. Burris:

Any action on the committee's part to write a project is really out of place as it is now and up until after the meeting in July. Right now this whole thing is in limbo. The Directors are not now considering any alternative methods for regional projects except through this task force.

Dr. Putnam:

Does this mean they couldn't have something prepared in case the Directors might change their minds?

Dr. Holland:

As my Director explained it to me, they have this philosophy of an interdisciplinary approach to solve problems. This is the

objective of getting nutritionists, geneticists, and physiologists working together. Wouldn't the program as we know it have little emphasis on beef cattle work? People are looking at the interdisciplinary approach of a problem and the idea is also involved in trying to establish priorities as what kind of research should be done in the Western Region.

Dr. Burris:

There is a need to do all the kinds of regional research that are in the National Task Force Report in the Western Region. It is quite extensive in what is described there. The task force has set up priorities on what should be done in the Western Region.

Dr. Cobb:

It seems to me that this committee should either keep our mouths shut "period," and take some of the things that have been said out of the minutes, or we had better go on record thanking the Directors for the support we have had over the years and tell them we are looking forward to seeing what is coming in the future and hope that breeding is a part of it. I think this is the positive approach, we don't dare take the negative approach. I think Dr. Burris is right, we aren't in a position to do anything until we know what the report of this task force is going to be. So if we take any action, it had better be of thanking them for the help we have had over the years and not the negative type of approach.

Dr. Burris:

I would say that everything we have in the minutes should stay in there, quite frankly. I think this discussion is healthy and necessary.

Dr. Bailey:

If we are going to hold another meeting, if that is decided, sometime or other either by ourselves or with another group, wouldn't that be the time to bring up the points that Dr. Cobb is making. Mainly that we would like to say that we appreciate what has been done over the past years and we would like to offer our services for the reorganized effort.

Dr. Bogart:

No, I believe this is the meeting we ought to pass that to a vote.

Dr. Butts, S-10 Coordinator:

We in the U.S.D.A. as well as in the State of Virginia spend quite a bit of time with animal associations and with experiment

station directors and the conclusion that I came out with on a lot of this discussion today is largely a lot of semantics. The same phrases were used from the administration standpoint in forcing us to plan on including Front Royal in the integrated approach. I think underlying it was something that we as a group have been guilty of, and I am not sure that you are not in the same boat. We had spent in the South, especially at Front Royal, far too many years doing the same thing. I think as an academic group we have perhaps spent too many years estimating the same genetic parameters each time a little more precisely. I got the impression that what they are sensitive to is what is asked by industry. Invariably they asked how have we helped the industry.

Another thing that seemed to be very much on their minds and it shocked me at the time, but as I thought more on it, it makes sense. We had a lot of long-time projects which were highly dependable and practical when they were initiated, but sometime in the intervening years before those projects gave an answer, the problem was answered through some other type of research. I think what I came out with is the beef cattle breeding work is going to have to be of a much shorter duration and more problem oriented. I just hope that we in S-10 have picked that up quickly enough to shift before we get in the position you folks are in right now. We are making a real effort there to reorganize our work to where it is in 5-year phases so that it can be more sensitive to this over-all approach. I think there is some justification for the action that they have taken; but if I am logical at all in making my point, the reasons that are given very briefly don't touch all the underlying changes that are necessary.

Dr. Burris:

There is one point I disagree with you on, I don't believe there is any move to eliminate long-term research. Long-term research is desirable and necessary. I know that this becomes difficult because project leaders change and no one has quite the same original project. There are a certain amount of inefficiencies in all types of research, but I don't think this is a goal. Maybe long-term research suffers because of some of these thoughts but I don't believe it is intentional

Dr. Butts, S-10 Coordinator:

I feel that it is a little illogical for us to set up a project that won't give us the answer in five years. I can't think of a problem so far that has required that long to get a workable answer. Now maybe it does take longer to get a real precise estimate. We already knew most of what we have today on these inbred lines 15 or 20 years ago. I think there are quite a number of projects in that same boat today, and they are going to be cut off because they are unfashionable and unpopular long before they really generate all the information they could get, just because we have been a little slow in proceeding.

Dr. Bogart:

Is this because we as researchers are not getting the material where people use it, or is it that the state extension service is not taking the information that we have and carrying it out to the public?

Dr. Butts, S-10 Coordinator:

No, we were not in a position to go to an overall view until we had the pieces, but we have quite a collection of pieces of information and I think the Directors want us to quit acquiring more pieces and start putting what we have together. Our research to date has not been with that goal in mind, it has been to get the estimates and move on into the next phase. The impression I get from some of the administrators is that they are trying to urge us into another phase of research without being really critical of what has been done.

Dr. Bogart:

I think the problem is with the cow herd sizes that we have. We are probably unable to get the kind of answer that you are talking about with the same program. In other words we have a choice of dropping out or trying to utilize smaller herds than the others. Let's face it, on most of these stations there are just so many physical facilities beyond which you are going to get the administration to go.

Dr. Sierk:

Let me try again to give you a little background, not necessarily to defend administrators, including directors, but for a moment at least to try to have you put yourselves in their position. Dr. Gregory used a very fine term when he said they are going to keep their program flexible all along. This is the position your Directors are in. If you get tied to a long-term project, this tends to take away the flexibility. We have had a great many planning groups from task forces to committees since the modern era in 1965 when a lot of this started. Actually before that, we had a livestock task-force study nationally that didn't ever see the light of day. This was followed by the long-range study that took all of agricultural research into consideration. The long-range study now called the National Program of Research for Agriculture assigned some man power priorities by research problem areas. There is an understanding here that also there is a division between the Department of Agriculture and the State Experiment Stations by research problem areas. There are only about 99 research problem areas covering all of agriculture research. At least they are organized in the best way that it can be organized, and this is a basic planning document. This presupposes that there will be some joint planning not only among the states but between the states and the Department of Agriculture in all our R.P.A.'s. Essentially that is the flexibility we referred to this morning when we said that a long range objective that is made now for 10 years hence must have some flexibility. Now

you are talking about things that are quite important, not only to you as individuals, but also with the industry with which you serve, which is really where your obligation is.

Last summer there was a joint Federal-State relations task force organized. This was chairmaned by the man who is currently the Secretary of Agriculture. The co-chairman was the Director of Science and Education in the Department of Agriculture. There were recommendations that came out of this task force. One of them on research planning was that there should be an Agricultural Research Advisory Planning Committee, jointly appointed by the Federal Government and the State Experiment Stations. This is to replace the old A.R.P.C. (Agriculture Research Planning Committee) appointed by the Secretary of Agriculture. Dr. Gregory reported to you earlier that the Advisory Committee of Clay Center was appointed by the Secretary of Agriculture. This is the only way the Secretary can do this. To get the Agriculture Research Advisory Committee on the board took a joint action of the Association of State Universities and Land Grant Colleges and the Secretary of Agriculture. It is planned that this group will meet for the first time early in June. This is an overall broad policy committee jointly made up of State and Federal people. There is one subcommittee on programs and facilities. Facilities are a very definite part of a national program of research for agriculture. Obviously there are still some recommendations to be made as to where the facilities might be located. Now this is getting down to planning at a pretty specific level.

All that I want to leave with you is: don't be disappointed, don't be pessimistic. You still have goods to sell and while you may not know exactly the shape of things to come, don't feel that you are alone in this particular position. Lots of Directors in research in the Department of Agriculture and Agriculture Experiment Stations don't have this either. You are being asked to respond to this with the best advice you can possibly give. You do have a revision of W-1 on the books, isn't that right? This could be drawn upon. As Dr. Burris indicated to you, perhaps not too long after the middle of July at least there will be some indications of what the Directors will ask in the way of developing a program of this type. So I think it is fine that you are discussing admixture philosophy in what way research ought to go particularly in the beef cattle industry. You can't remove yourselves with being concerned with the whole industry no matter what particular speciality you are in. You can rest assured, I think, that good research is going to be continued to be supported and there will be a lot of increased programs in it.

I want you to understand that there is a terrific amount of planning and this is directed primarily at budget preparation. I think there is still a terrific amount of flexibility still existing in it even though you may have all these pigeon holes. They will be filled some way. It does take some planning and administrators are looking for assistance.

B U S I N E S S M E E T I N G

COMMENTS OF CHAIRMAN

Dr. Blackwell:

First I want to introduce some people here: Dick Quesenberry, a former Superintendent of the U.S. Range Livestock Experiment Station here at Miles City; Carl Sierk, Assistant Administrator, Cooperative State Research Service; Paul Putnam, Chief, Beef Cattle Research Branch, Beltsville; Kay Stoner, the new secretary that took Mrs. Neely's place; and her husband Charles Stoner.

I want to read a portion of a letter that I received from Dr. Meyer our Administrative Adviser. This is dated April 22. It says:

"The change in dates for the W-1 meeting from May 9-10 to May 8-9 will make it impossible for me to attend. This in addition to my new duties as Chancellor prompted me to consult with Dr. Kelly and Director Asleson of the Montana Experiment Station. Dr. Asleson will fill in as Administrative Adviser."

Dr. Meyer is leaving the role of Dean and Director at Davis and is becoming Chancellor at Davis so that explains why he is not here. Dr. Burris is acting as Administrative Adviser of this group at this time.

COMMENTS OF S-10 COORDINATOR

Dr. Butts:

I really don't have a thing to say other than I have enjoyed the meeting.

I have an announcement that I think all of you probably know about. We are disposing of the Hereford inbred lines and polled inbred lines in three selection lines at Front Royal this year. If any of you have a place for those cattle or a use for them, we would certainly like to see them go where they will do the most good. You are probably all familiar with that project. It is entering its final phase now with the termination in 1974. The Herefords will go this year, the Angus and Shorthorn will continue until 1974. Get in touch with Dr. Carter or Dr. Bovard at the Station if you are interested.

COMMENTS OF NC-1 COORDINATOR

Dr. Cundiff:

I brought some handouts that will summarize the NC-1 program. First of all, I would like to say that I am glad I came. The thing that I detected is there is quite a different philosophy among technical committee members of this committee and the committee I am associated with in the North Central Region. This is reflected in our projects.

This project was approved by the Directors in 1967. We are anticipating it will be ready for review in 1972. The first four objectives had to do with biological components relative to those traits, trait measurement, and indirect estimates of genetic relationships and parameters involved. The fourth one is being attack through direct selection experiments. Actually objectives four, five, six, and seven pretty well dictate the design of the experiments we have in the NC-1 project.

Table One gives a summary of the five selection experiments in NC-1. The table outlines the selection criteria for the various lines and methods of control or measurement of response. We will comment briefly on the status of each of these projects.

The Illinois project is still pretty much in the paper stage. The whole body counters were in Urbana, Illinois, and the cattle were in the southern part of the state. This represents a real difficulty in logistics. The project was approved about two years ago but it really hasn't been implemented yet.

The Michigan project is beyond the first generation of selection. This is very unique in that selection is direct for carcass traits. Selection was for percent of preferred lean, which amounts to percent of closely trimmed boneless retail cut, round, and loin adjusted for carcass traits. Also selection was for tenderness as evaluated by the index approved by the State Panel Evaluation and Warner-Bratzler Shear Evaluation for all the bulls produced each year. Dr. W. T. MaGee, the leader of this project, had collected semen on the bulls prior to slaughter and stored this semen until the evaluation on the bulls was made. Then he used the semen and bred the cows by A-I. The biggest problem that he has in this experiment is fertility, that is the reproductive rate isn't what you'd like from these bulls by A-I. We think this is associated really with the age that it is collected.

The experiment at Fort Robinson is the oldest and the farthest along in the Region. It has three lines of 150 cows each with 6 sires in each line. The third line for yearling weight and muscle score is beyond one generation now. The cattle range now from three-fourths to better than two generations in selection. Preliminary

analysis indicates a heritability of about 60% for yearling weight and yearling line. It was higher than expected in the weaning weight line at this point. I think it was around 38%. The index was around 50% heritable. All this is summarized in the last NC-1 report. It was also presented in an abstract at Oklahoma last summer.

The project in Oklahoma is more recent and the unique characteristic of this experiment is that it not only involves mass selection for weaning weight and yearling weight but also involves the evaluation of progeny testing and gives some information relative to efficiency of progeny testing compared to mass selection. Dr. Frahm, the project leader, has changed the selection criteria since I made up this table. This was before it was very far along so it didn't hurt anything. The progeny tested lines are selected for the same traits as the mass selection lines.

The other project that represents a major effort in NC-1 does relate to evaluation of additive and nonadditive differences between breeds. Table 3 outlines the design of the experiments, which is exactly the design of the Fort Robinson project.

Iowa has started out with four breeds with basically the same design. Some are two breeds where they use a third breed in the second phase to evaluate maternal heterosis. Table Four summarizes the five projects involved in heterosis experiments which involves seven breeds. The objective is to evaluate these breeds as the data is available for their additive and nonadditive genetic differences on a regional basis. I hope to do something along this line about 1971 when Phase 1 is finished in all the experiments. The Nebraska experiment has now actually entered the Third Phase to evaluate the straightbreds, two-way crisscrosses, and three-way rotations which are all produced together. The Ohio work is in the second phase which is evaluation of maternal heterosis in female reproduction traits.

There are two inbreeding experiments in the Region. The Kansas project involves two Shorthorn lines. The inbreeding in the small lines is around 30%, while the larger line is around 20%.

We have a study in Wisconsin involving identical twins, and they finished up the third cycle on this involving two levels of energy for the cows. They get the identical twin heifers when they are four months old and produce three calve crops with them. Then they measure the individual feed consumption of the cows and the calves from the time those cows were four months old until they go off the test.

We have a new genotype environmental interaction study in South Dakota involving more or less semi-confined management versus range management superimposed on a Charolais-Angus heterosis design. This has just started this last year with the purchase of the females. Some of the other heterosis projects do relate to this, where they do have different planes of nutrition involved.

HAND-OUT MATERIAL

IMPROVEMENT OF BEEF CATTLE THROUGH BREEDING METHODS (NC-1)

Objectives of Regional Project NC-1

1. Determine the traits and their biological components that contribute to net merit in beef cattle.
2. Assess the relative values of economic traits.
3. Develop the most effective methods and procedures for measuring and evaluating traits that contribute to net merit.
4. Obtain estimates of heritabilities of traits that contribute to net merit and of the genetic and phenotypic correlations among all economically important traits.
5. Evaluate the effects and uses of inbreeding and heterosis.
6. Evaluate the importance of different types of genetic-environmental interactions.
7. Compare different breeding and selection procedures in effectiveness for making genetic improvement in the traits of economic value.
8. Determine the mode of inheritance of defects, lethals and semi-lethals, and develop methods of controlling them.

PERSONNEL ON REGIONAL PROJECT NC-1

Administrative Adviser	Roy M. Kottman*
Investigations Leader, NC-1	L. V. Cundiff**
Illinois	H. W. Norton
Indiana	T. G. Martin
Iowa	R. L. Willham
Kansas	W. H. Smith
Michigan	W. T. Magee
Minnesota	W. J. Boylan
Missouri	J. E. Comfort and J. F. Lasley
Nebraska	R. M. Koch
North Dakota	M. L. Buchanan
Ohio	E. W. Klosterman
Oklahoma	J. V. Whiteman and R. R. Frahm
South Dakota	C. A. Dinkel
U.S. Meat Animal Research Center	K. E. Gregory***
Wisconsin	E. R. Hauser

*Dean, College of Agriculture, Ohio State University, Columbus, Ohio, and Director, Ohio Agricultural Research and Development Center, Wooster, Ohio.

**Beef Cattle Research Branch, Animal Husbandry Research Division, ARS, USDA, 217 Marvel Baker Hall, University of Nebraska, Lincoln, Nebraska.

***Director, U.S. Meat Animal Research Center, Animal Husbandry Research Division, ARS, USDA, Box 166, Clay Center, Nebraska.

TABLE 1. SELECTION EXPERIMENTS IN REGIONAL PROJECT NC-1

State	Selection Criteria	No. of Cows	No. of Bulls	Method of Control	Comments
Illinois	Random	40	2	Random Control	Whole body muscle mass is estimated by individual measurement of K-40 radio activity by means of a large liquid scintillation counter.
	Random	40	2	Random Control	
	Random	40	2	Random Control	
	Whole body muscle mass	40	2	Random Control	
	Whole body muscle mass	40	2	Random Control	
	Whole body muscle mass	40	2	Random Control	
	Weaning weight	40	2	Random Control	
	Weaning weight	40	2	Random Control	
	Weaning weight	40	2	Random Control	
		40	2	Random Control	
Michigan:	% preferred lean	40	2	Repeat sire	Semen is collected on all bulls prior to slaughter and measurement of selection criteria.
	Tenderness	40	2	Repeat sire	
Missouri:	Yearling weight	100	4	Repeat sire	
	Index: yrling. wt. and conf.	100	4	Repeat sire	

Continued next page

TABLE 1. SELECTION EXPERIMENTS IN REGIONAL PROJECT NC-1 (Continued)

State	Selection Criteria	No. of Cows	No. of Bulls	Method of Control	Comments
Nebraska and AHRD, ARS, USDA:					
L1	Weaning Wt.	150	6	Repeat sire, frozen semen	
L2	Yearling Wt.	150	6	Repeat sire, frozen semen	
L3	Index: Yr. wt. + Muscling sc.	150	6	Repeat sire, frozen semen	
Oklahoma and AHRD, ARS, USDA:					
L1	Weaning Wt.	50 Hereford	4	Repeat sire, frozen semen	In line 6, out-
L2	Yearling Wt.	50 Hereford	4	Repeat sire, frozen semen	side sires may
L3	Weaning Wt.	50 Angus	4	Repeat sire, frozen semen	be introduced
L4	Yearling Wt.	50 Angus	4	Repeat sire, frozen semen	by progeny test.
L5	Progeny growth rate and carcass merit, closed	50 Angus	4	Repeat sire, frozen semen	
L6	Progeny growth rate and carcass merit, open	50 Angus	4	Repeat sire, frozen semen	

TABLE 2. PHASE I OF HETEROSIS EXPERIMENTS IN REGIONAL PROJECT NC-1

Dams	Sires		
	A	B	C
A	AA	BA	CA
B	AB	BB	CB
C	AC	BC	CC

Heterosis is measured by comparing performance of crossbred calves to that of their straightbred half sibs.

TABLE 3. PHASE II OF HETEROSIS EXPERIMENTS IN REGIONAL PROJECT NC-1

Dams	Sires		
	A	B	C
A		BA	CA
B	AB		CB
C	AC	BC	
AB and BA			C x (AB)
AC and CA		B x (AC)	
BC and CB	A x (BC)		

Object is to compare crossbred cows with their straightbred half-sisters when both produce crossbred calves by the same sires.

$$H_{BC} = [A \times BC] - \frac{[AB + AC]}{2}$$

TABLE 4. HETEROSIS EXPERIMENTS IN REGIONAL PROJECT NC-1

State	Breeds	No. of Cows	Number of sires (per year)
Indiana	Angus	75	16 (4)
Phase I in progress	Milking Shorthorn	75	16 (4)
Iowa	Angus	200	20 (10)
Phase I being initiated	Hereford	200	20 (10)
	Brown Swiss	200	20 (10)
	Holstein	200	20 (10)
Missouri	Angus	72	24 (4)
Phase I in progress	Hereford	72	24 (4)
	Charolais	72	24 (4)
Nebraska	Angus	37	22 (4-3)
Phase II in progress	Hereford	37	22 (4-3)
	Shorthorn	28	22 (4-3)
	A x H and H x A	46	
	A x S and S x A	39	
	H x S and S x H	41	
Ohio	Hereford	35	6 (2)
Phase II is in progress	Charolais	35	6 (2)
	H x C and C x H	70	6 (2)

TABLE 5. INBREEDING EXPERIMENTS IN REGIONAL PROJECT NC-1 a/

	Line	Breed	Cows	Sires/Year
Kansas	Line 1	Shorthorn	20	1
	Line 2	Shorthorn	40	2
South Dakota	Line 1	Hereford	15	1
	Line 2	Hereford	15	1
	Line 3	Hereford	15	1
	Line 4	Hereford	15	1
	Control	Hereford	60	4

a/ Heterosis among inbred lines is being evaluated at the South Dakota Station presently.

Discussion

Dr. Bailey:

Have any conclusions been run in regard to the effectiveness of repeat sire matings as a method of control in contrast to say a control herd?

Dr. Cundiff:

Yes, Dr. Dickerson is working on this one. It doesn't look very good for repeat matings any way you want to look at it. In the Fort Robinson Line they still have a number of the foundation herd cows around and frozen semen from the foundation bulls. They are involved at the present time in a program to reproduce the foundation cattle to serve as a management control for the duration of the experiment. It takes a large cow herd to do it that way, and we only measure half of the genetic change as opposed to a control which measures it all. There are small standard errors and a whole grade of advantages. In the repeat systems you have to measure every trait from the beginning to the end that you can evaluate to really measure correlated response, whereas, in the controls you don't. I think we will see this more in our selection experiments, and we are going to try to encourage the use of management controls.

COMMENTS OF CHIEF, BEEF CATTLE RESEARCH BRANCH

Dr. Putnam:

I am aware of the fact that there has been some strain in relation to Federal and State efforts in W-1, principally in the rather recent budget cut that we undertook which affected several of you directly. All I can say is that some things are out of our control. I am sorry but hopefully perhaps we may be able to recoup some of the losses that occurred from that.

In addition I would also like to say a word about the vacancy of the coordinator. I appreciate the efforts that Mr. Knapp has been putting in, but I realize that he has other responsibilities. As a result, he might not be able to do everything for you folks that you would like. I do hope that in the near future we will be able to get a full-time researcher in that position who will be able to work with you people on a coordinator-cooperative basis if things develop that way.

I would like to emphasize the point made by both Dr. Sierk and Dr. Gregory in relation to the cost benefit ratios. At least in the Federal house we are pretty well brain-washed on this. I have seen

Dr. Bogart's reaction in several other places when you toss out this philosophy about cost benefits in research. You can't come up with the exact answers as Dr. Bogart indicated, but you can come up with a reasonable estimate of what you might anticipate and a possible return on your dollar invested. I do think we have to be sensitive to this if we go to bat and fight for our research dollars in the legislature.

As far as the Beef Cattle Branch itself is concerned, we do plan to continue support with the program in this Region as well as others in relation to the cooperative support at our field stations which are intimately involved and depend upon State efforts. We also plan to continue our efforts as far as cooperative agreements and contracts are concerned if we ever can get some of the financial support that we feel we need.

To close out I think, in view of the discussion that we heard today and at other meetings of this type, that the nature of research in breeding genetics is going to change from what has been the traditional outlook in relation to the Federal effort, the effort at Clay Center, and the State Experiment Station efforts. There may be a problem in this, but it looks like it is happening. I think we ought to take advantage of the opportunities as they exist to move with the times if that is the way it is going to be.

NEW AND OLD BUSINESS

Dr. Blackwell:

I have a memo from Dr. Gregory and Dr. Whiteman relative to the joint meeting of NC-1, W-1, and S-10. I guess in order for this to be just that, we are going to have to change the calendar somehow or other unless there is a reprieve. Just where do we stand in this regard, Dr. Burris? Can we assume that the Directors will permit us to meet on the dates specified in this memo which is August 10, 11, and 12, 1970, which will be after the date of our demise; or should we approach Dr. Gregory and the other two regions to see if we can shift the date maybe a little before the writing of the epitaph.

Dr. Burris:

My thought would be if this coordinating committee does not come into effect and there isn't a successor to W-1, then this group would not be meeting as a technical committee of W-1 on that date. The people could meet with the group as individuals and this sort of thing. I suppose there is always the possibility that there might be some reason for your Directors saying this is a planning coordinating committee of some sort; and therefore, you can use regional funds on it, but you wouldn't be meeting as a W-1 project.

Dr. Gregory:

To prove our flexibility, we established this date at the request of W-1, and we are willing to change at the request of W-1 if that is appropriate. The objective was to coordinate it with the American Society of Animal Science meeting which is to be held at Pennsylvania State University that year.

Dr. Blackwell:

We didn't anticipate this emergency. What about meeting before June 30th?

Dr. Gregory:

It wouldn't be nearly as good.

Dr. Bogart:

It seems to me to be rather obvious, I know it is true at my station, that if we meet after July 1, chances are there will be no money for our attendance. If there won't be a technical committee at that time, I am sure our Directors won't want to throw money out from other projects to do this. My thinking would be that we have one of two choices--change the meeting date or we won't be there.

Dr. Blackwell:

There is one other alternative. Dr. Sierk visited with me about the possibility of asking the Directors to form a committee to hold the group together and call it a coordinating committee.

Dr. Sierk:

I think the group has to be optimistic, and that there will be something that will be classified as a beef cattle project. Maybe the word breeding will not be in it. As I understand the program at Clay Center, it is not going to be only breeding. There will be opportunities for essentially this group or representatives of a group such as this to meet.

Dr. Burris:

Wouldn't this essentially be the first part of business for the reconstituted committee?

Dr. Roubicek:

On the other hand that type of meeting might do a great deal to help guide the thinking of a new reorganization in this group.

Dr. Bailey:

When will this reorganization be put into effect? Will it be before that time?

Dr. Burris:

I think probably something relative to a committee will come out of the July meeting of the Western Directors. Probably at that time if they feel that a beef cattle project of some sort involving some of the people on this committee is desirable, they will ask that a committee be formed to set up plans for this within that fiscal year. Naturally, it would be before February, so you have about a six-month period there. There probably would be a meeting called of some group prior to February 1970.

Dr. Blackwell:

Then is it the consensus of the W-1 Committee that we not ask the host to change the dates? Shall we go ahead and plan the meeting at Clay Center? If W-1 or some other W Committee isn't there, this will be too bad; but the other two regions can get together.

Dr. Brinks:

I move we leave the dates the same and just plan on being there.

Dr. Nelms:

I second it.

Dr. Bogart:

I want to raise one question about that motion. I think we should leave out planning to be there and say leave the date the same.

Dr. Blackwell:

Strike planning to be there.

Motion carried.

Dr. Blackwell:

Is there any new business before the committee or an extension of the old business? Is there any ground we wanted to cover that we haven't?

Dr. Cobb:

I think it would be appropriate for this group to convey to the Directors our feelings about attending the Nebraska meeting. This probably should be in the form of a resolution that it would be desirable for this group to attend the meetings in Nebraska.

Dr. Blackwell:

I think then this would be a good time to appoint a resolution committee to do this. Dr. Christian will you chairman such a committee and Dr. Nelms and Dr. Roubicek will you serve on the committee? Bring back a report of any resolutions that you people want to direct to anyone later in the meeting.

Is there any other old business that we need to get out in the open? Any new business?

Mr. Knapp:

We got all but three reports and they know who they are. The rest of your reports are due June 15 which will be your postweaning and cow inventories, etc.

Dr. Bailey:

What is the status of the bulletin?

Mr. Knapp:

It got a little behind in January due to the 10-year project review, but it will be ready to analyze next month.

Dr. Bogart:

What about the literature review? Is that coming along pretty well?

Dr. Brinks:

Dr. Rollins is working on the literature review. I got a few more material and methods and a few more papers put together but that is all.

Dr. Bogart:

Are we going to get these prepared by June 30, 1970?

Dr. Brinks:

The first main ones we could.

Dr. Bogart:

Could we get all the data analyzed by then?

Mr. Knapp:

Right now I don't know why we couldn't unless they change computers on us again.

Dr. Bogart:

I think the people that are delegated to do the writing could go ahead and get this kind of a job done. The State Station people could get together to do this, don't you think?

Dr. Bailey:

I was just wondering, maybe it is implied, is this our final meeting? Should we consider alternatives or how does this all fit together in a positive winding up of 20 years of effort? Should we prepare a summary of this?

Dr. Blackwell:

I presume there will be a meeting next year.

Dr. Bailey:

You mean prior to July 1, 1970

Dr. Blackwell:

Yes, it seems to me that there should be.

Dr. Burris:

I doubt if there is going to be two meetings, one in June and one in August.

Dr. Bogart:

That is why I asked Dr. Brinks to leave out that we would be there in August, because I thought we might decide we want to have a meeting of our own instead. I think we would want to see how the situation is developing before we make a decision.

Dr. Bailey:

You mean when we would have the meeting? I thought we passed a motion to this effect.

Dr. Bogart:

We could leave the motion as it is because all we said was to go ahead with that date.

Dr. Blackwell:

Dr. Burris, let's be optimistic now. Why would there not be another meeting of W-1 in Fiscal 1970 presumably the last one, and then why would not any new one (either the same one or the new organization) meet with the other two committees the next fiscal year? Why would this be excluded?

Dr. Burris:

I guess it probably wouldn't be. I think it would be a little inappropriate to think that the same committee would meet in June and August. We as a committee planned to meet in Nebraska in August next year. If there is an entirely different committee, then this August meeting isn't too much of a concern to W-1.

You do have the problem of making a final report of W-1. I would suggest that this could be handled essentially by correspondence, I think such as the work was done on the 10-year summary. I don't know if you feel you need a committee meeting for this purpose. I guess perhaps the thing to decide is what would you do if you had a committee meeting next year.

Dr. Christian:

The Resolution Committee composed of Dr. Nelms, Dr. Roubicek, and myself prepared the following resolution:

WHEREAS the staff of the U.S. Range Livestock Experiment Station has provided an excellent program and facilities for the 1969 W-1 Meeting, be it resolved that the W-1 Technical Committee express its sincere thanks to Dr. Pahnish and his staff.

This is the only resolution from the Resolution Committee, Mr. Chairman.

Dr. Roubicek:

I move the resolution be adopted.

Dr. Bogart:

I second it.

Motion carried.

Dr. Pahnish:

Thank you, gentlemen. It has certainly been our pleasure to have all of you here with us. We hope that this opportunity will arise again. Whether you come as this group, as another group, or as individuals, we would be glad to have you any time.

Dr. Blackwell:

It has been the tradition that the chairmanship rotates alphabetically by states. I guess unless there is a reason to change it, it is Nevada's turn.

Dr. Christian:

I nominate Dr. Bailey for chairman for next year.

Dr. Nelms:

I second it.

Motion carried.

Dr. Blackwell:

I also believe it has been tradition that the old chairman steps down now and the new chairman takes over.

Dr. Bailey:

Is there any other business to be handled at this time? Did we ever decide what we were going to do about the meeting? Are we going to move ahead on the Clay Center meeting in 1970 or hold one during the coming fiscal year? Would anyone like to discuss this subject?

Dr. Bogart:

It seems to me what we had better do is delay reaching any decision until we see how things are going and what we want to do. I think we would want to have a meeting to finalize this report, take care of these motions, and make plans on how we are going to complete the publications.

Dr. Bailey:

In other words postpone the decision as to whether or not we will have a meeting during the coming fiscal year until we know the future of this organization and the evolution of the new technical committee. Then decide by mail after we have this further information, as to whether or not we will go ahead with the committee meeting during the coming fiscal year.

Dr. Cobb:

Mr. Chairman, I move that we give the executive committee the power to make this decision with whatever checking they need to do with the committee.

Dr. Bogart:

I second the motion.

Motion carried.

Dr. Bailey:

Is there anything else to be considered here?

Dr. Christian:

There is only one problem. One member of the executive committee is usually the technical committee member from the host institution for the next meeting.

Dr. Bailey:

Who will be on the executive committee?

Dr. Bogart:

There will be Dr. Bailey, Dr. Blackwell, and Mr. Knapp.

Dr. Bailey:

Is there anything else to be taken up at this time? All right then, the meeting is adjourned.

